U.S. DEPARTMENT OF COMMERCE
National Technical Information Service

PB-264 870

Oil Spill and Oil Pollution Reports May 1976-July 1976

California Univ, Santa Barbara Marine Science Inst

Prepared for

Industrial Environmental Research Lab, Cincinnati, Ohio

Oct 76

PB 264 870

EPA-600/2-76-266
October 1976

Environmental Protection Technology Series

OIL SPILL AND OIL POLLUTION REPORTS
May 1976 — July 1976

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2. Environmental Protection Technology
3. Ecological Research
4. Environmental Monitoring
5. Socioeconomic Environmental Studies

This report has been assigned to the ENVIRONMENTAL PROTECTION TECHNOLOGY series. This series describes research performed to develop and demonstrate instrumentation, equipment, and methodology to repair or prevent environmental degradation from point and non-point sources of pollution. This work provides the new or improved technology required for the control and treatment of pollution sources to meet environmental quality standards.

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TECHNICAL REPORT DATA
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1. REPORT NO. EPA-600/2-76-266	2.	3. RECIPIENT'S ACCESSION NO.
4. TITLE AND SUBTITLE OIL SPILL AND OIL POLLUTION REPORTS MAY 1976 - July 1976		5. REPORT DATE October 1976 (Issuing Date) 6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) Penelope Melvin and Helmut Ehrenspeck		8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS Marine Science Institute University of California Santa Barbara, California 93106		10. PROGRAM ELEMENT NO. 1BB041 11. CONTRACT/GRANT NO. R-803992
12. SPONSORING AGENCY NAME AND ADDRESS Industrial Environmental Research Laboratory Office of Research and Development U.S. Environmental Protection Agency Cincinnati, Ohio 45268		13. TYPE OF REPORT AND PERIOD COVERED Quarterly May - July 1976 14. SPONSORING AGENCY CODE EPA/600/12

15. SUPPLEMENTARY NOTES See also EPA-670/2-75-003, PB-240 719; EPA-670/2-75-044, Pb-242 542; EPA-670/2-75-059, PB-243 724; EPA-600/2-76-113, PB-258 745; EPA-600/2-76-129, PB-258 852; EPA-600/2-76-185, PB-257 886; EPA-600/2-76-215

16. ABSTRACT

The May 1976 - July 1976 Oil Spill and Oil Pollution Report is the eighth quarterly compilation of oil spill events and oil pollution report summaries. Presented in the report are: (a) summaries of oil spill events; (b) summaries and bibliographic literature citations; (c) summaries of current research projects; and (d) patent summaries. This report is submitted in partial fulfillment of EPA Grant No. R-803992 by the Marine Science Institute, University of California, Santa Barbara, under the sponsorship of the Environmental Protection Agency.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
*Bibliographies *Summaries *Patents *Documents *Research	Oil pollution Oil spill events Oil spill research Oil pollution control Oil pollution patents	13B

18. DISTRIBUTION STATEMENT Release to public	19. SECURITY CLASS *(This Report)* Unclassified	21. NO. OF PAGES 357
	20. SECURITY CLASS *(This page)* Unclassified	22. PRICE A16-A01

EPA Form 2220-1 (9-73)

☆USGPO: 1977 — 757-056/5459 Region 5-II

EPA-600/2-76-266
October 1976

OIL SPILL AND OIL POLLUTION REPORTS

May 1976 - July 1976

by

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FOREWORD

When energy and material resources are extracted, processed, converted, and used, the related pollutional impacts on our environment and even on our health often require that new and increasingly more efficient pollution control methods be used. The Industrial Environmental Research Laboratory - Cincinnati (IERL-Ci) assists in developing and demonstrating new and improved methodologies that will meet these needs both efficiently and economically.

This report is a product of the above efforts. It cites current events, literature, research, patents, and other material relevant to the oil pollution abatement program and is published in an abstract format on a quarterly basis. As such, it serves as a basic reference document for all those interested in oil spill and oil pollution control. This project is part of the continuing program of the Oil & Hazardous Materials Spills Branch, IERL-Ci to assess and mitigate the environmental impact of oil pollution.

David G. Stephan
Director
Industrial Environmental Research Laboratory
Cincinnati

ABSTRACT

OIL SPILL AND OIL POLLUTION REPORTS is a quarterly bulletin designed to review current scientific and technical publications and research projects in the field of oil pollution. Subject coverage includes all aspects of aquatic and terrestrial oil pollution. This issue contains summaries of research projects and documents selected from the scientific and technical literature during the period May, 1976 through July, 1976.

The following sections are included in the report:

I. Reports, Publications, and Patents

II. Current Research Projects

III. Current Oil-Related Conferences

This report is submitted in partial fulfillment of EPA Grant No. R803992-01 by the Marine Science Institute, University of California, Santa Barbara, California, under the sponsorship of the Environmental Protection Agency.

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ACKNOWLEDGEMENTS

The authors would like to thank Ms. Kathy Courtney for typing the camera-ready copy of Oil Spill and Oil Pollution Reports. We also wish to thank the personnel of the Science-Engineering Library, University of California, Santa Barbara, for their professional assistance during the research stages of the project, and Mr. Bruce Harger for his efforts in developing the computer program for the Subject Index.

INTRODUCTION

OIL SPILL AND OIL POLLUTION REPORTS is a quarterly bulletin which reviews pertinent scientific and technical publications and research projects to provide its readers with current developments in the field of oil pollution. This issue contains summaries of reports, publications, and patents relating to oil pollution published during the period 1974 to 1976 (Section I); summaries and status of current research projects (Section II); and current oil-related conferences (Section III).

The subject coverage includes all aspects of aquatic and terrestrial oil pollution. Items in Section I are categorized by seven major subdivisions divided into thirty-four specific subject categories. These are presented in the Table of Contents. Patents and patent applications are announced in this section under appropriate subject categories. Sources of the citations appear in the list of Periodicals Reviewed in the Appendix.

For indexing purposes each abstract in Section I is assigned certain keywords which highlight the main points in the entry material. The Subject Index, which is a permuted index listing alphabetically the keywords and citation number of each abstract, appears at the end of the report. The Master List of Keywords is also included at the end of this issue. Official names of countries and geographic regions of the world were obtained from The Statesman's Yearbook 1975-1976 (John Paxton ed., New York, St. Martin's Press, 1975) and U.S. Board on Geographic Names. Gazetteer. (prepared by U.S. Department of the Interior).

Section II presents titles of active or recently completed oil pollution research projects, summaries of project objectives, and current status information and/or resulting publications provided upon request by the principal investigators or performing organizations. Notices of research projects were obtained from the Smithsonian Science Information Exchange (SSIE), Maritime Research Information Service Abstracts (MRIS), Aquatic Microbiology Newsletter, and Environmental Research, American Petroleum Institute Annual Status Report. Entries are arranged according to the same subject categories as in Section I and are ordered by serial number within each subject division. Some of the current projects listed in previous Oil Pollution Reports have been recently renewed. These projects have been relisted and headed by the same serial number as originally reported, followed by the word (renewal). Renewal entries are listed at the beginning of each subject category.

Section III, Current Oil-Related Conferences, contains descriptive information on recent and future conferences relating to environmental oil pollution. Conference dates are listed; and, when information is available, titles, authors, and abstracts of conference papers are included. All information for this section was obtained from the periodicals reviewed (Appendix) and from responses to personal inquiries concerning the symposia.

Sections I and II have their own serial numbers. The letters preceding the serial numbers designate the following: C, reports, publications, and patents; and R, research projects.

SECTION I. REPORTS, PUBLICATIONS, AND PATENTS

A. OIL POLLUTION DETECTION AND EVALUATION

1. REPORTING

C-1237-76
No title given (news brief)

Anon. 1976.
Audubon 78(2):140.

Oil discharges, Fuels

The General Accounting Office reports that the U.S. Navy has dumped at least 50 million liters of waste fuel at sea in the last 2 years. In 1975, the aircraft carrier "Independence" dumped nearly 33,700 liters of aviation gasoline off South Carolina.

C-1238-76
ANNUAL REPORT OF THE STREAM POLLUTION CONTROL BOARD OF THE STATE OF INDIANA: FISCAL YEAR JULY 1, 1974 TO JUNE 30, 1975

Anon. 1975.
Indiana Stream Pollution Control Board, Annual report. 93p.

Oil spills, Law enforcement,*Stream Pollution Control Board, *Indiana

Among its diverse activities, the Board investigated 387 water pollution complaints, 190 oil spills and hazardous material spills, and 23 fish kills. The Board also administered, monitored, and enforced requirements of state and federal pollution control legislation.

[from Pollution Abstract 7(2):#76-01307. 1976.]

C-1239-76
CHESAPEAKE SPILL CALLED ECOLOGIC DISASTER (news brief)

Anon. 1976.
National Fisherman 56(12):28A.

Oil spills, Biological effects, Birds, Chesapeake Bay

The article mainly describes the ecologic damage caused by an oil spill in Chesapeake Bay on Feb.1, 1976. A sinking barge spilled over 800 metric tons of a heavy, viscous industrial fuel oil, which then spread over a wide region. The report indentified various species of waterfowl killed by the spill and indicated that about 10,000 birds, mostly migratory species, had died or would die as a result of the spill.

C-1240-76
COOK INLET WINS CLEAN BILL IN GOVERNMENT OIL SPILL STUDY

Anon. 1976.
Offshore 36(5):282.

Oil spills, Alaska, Gulf of, Offshore development, Petroleum industry

Alaska's Division of Oil and Gas has found that oil development and production has resulted in a negligible amount of oil spillage in the last five years. A total reported spillage of 145 barrels resulted from oil activity from 1971 to 1975. During the same time, non-oil industry related spillages accounted for 2,141 barrels.

C-1241-76
ICEBERG HAZARD FOR ALASKAN OIL (news brief)

Anon. 1976.
Marine Pollution Bulletin 7(2):20.

Oil transport, Tankers, Alaska, Gulf of, *Glacial retreat

A report from the U.S. Gelolgical Survey warns that icebergs from 1100 km^2 Columbia Glacier in Prince William Sound may be hazardous to supertankers which pass through these waters to Port Valdez, Alaska. Glaciologists suspect that the glacier may be on the verge of retreat, and that up to 200 cubic km of ice might be discharged into the Sound over the next 30-50 years.

C-1242-76
INTERSPILL NETWORK

Anon. 1976.
Marine Pollution Bulletin 7(2):21-22.

Information systems, Oil spills

The Center for Natural Areas is seeking to establish an informal network of scientists and professionals conducting spill research who would be interested in exchanging spill information. To promote "Interspill", the Center has compiled a computer-based directory of 57 selected oil spills occurring between 1962 and 1975. (FFI contact J. Whitman, Staff Associate, Center for Natural Areas, 1525 New Hampshire Ave., N.W., Washington D.C. 20036).

C-1243-76
MORE FISHERMAN/OIL PROBLEMS(news brief)

Anon. 1976.
Marine Bulletin 7(2):20.

Offshore exploration, Physical effects, Biological effects, Fisheries

The Shetland fleet of fishermen has made 14 claims against oil companies for compensation for damage to gear caused by offshore exploration and production activities. Hampshire and Dorset fishermen have complained about the oil production of their fishing grounds and there have been reports of flat fish with an oily taste.

C-1244-76
OFFSHORE OIL (news brief)

Anon. 1976.
Alaska Seas and Coasts 4(2):8-9.

Oil-gas leasing, Alaska, Gulf of

The article reports the decision of the U.S. Department of the Interior to continue with the controversial oil and gas lease sale in the northeastern Gulf of Alaska. The Gulf sale is the first in a series of nine offshore lease sales which are slated for Alaska's outer continental shelf over the next three years.

C-1245-76
'GHOST' OIL SLICKS HAUNT WEST COAST

Browning, R.J. 1976.
National Fisherman 57(2):16A.

Oil slicks, Coasts, Legislation, *Northwest coast

A series of oil slicks which touched the coastline from Oregon to British Columbia in March have caused many conservationist forces to demand federal action. Since the slicks are believed to have originated in international waters from bilge cleaning of several ships, no legal action has been taken.

C-1246-76
MANAGING AN INLAND OIL SPILL

Elliot, P.R. 1976.
Industrial Pollution Conference, 4th, Houston, Texas, 1976. McLean, Virginia, Water and Wastewater Equipment Manufacturers Association, 1976. p.XX1-XX2. Abstract.

Oil spills, Cleanup, New York

An oil spill incident in 1973, in which over 26,000 liters of an asphalt-kerosene mixture were released from a storage tank into the Hackensack River, is described. EPA responses, cleanup procedures, and problems encountered during cleanup are detailed.

C-1247-76
OIL AND HAZARDOUS MATERIALS SPILL INFORMATION RETRIEVAL SYSTEM USER'S MANUAL (OHM-SIRS)

Environmental Protection Agency. 1975.
EPA/DF-75/001A, PB-243662/4. 17p.

Oil spills, Information systems, Guidelines

An oil spill and hazardous materials information data base has been established by the EPA. This publication is a guidance manual for those who prepare spill reports to the Division of Oil and Special Materials Control, and for those who need access to the information retrieval system.

[from Scientific and Technical Aerospace Reports 14(5):#14658. 1976.]

C-1248-76
WAVES OF OIL

Hann, R.W., Jr. 1975.
Defenders of Wildlife News 50(3):276-282.

Biological effects, Oil spills, Metula oil spill, Birds, Shorelines

The Metula oil spill disaster in the Strait of Magellan in 1974 is reviewed. The effect of oil on waterfowl, particularly cormorants and penguins, and on seashore life is estimated. A description of the shoreline affected by the spill is given.

C-1249-76
CRACKING DOWN, OIL REFINING AND POLLUTION CONTROL

Kerlin, G., and D. Rabovsky. 1975.
New York, Council on Economic Priorities, 1975. 478p.

Refineries, Law enforcement, *Pollution control records

This book tells which oil refining companies have the best and worst air and water pollution control records, what compliance technology has been developed, and how pollution control can result in cost, material and energy savings. It also explains how control varies as to region and why government enforcement is the single greatest pollution control determinant.

C-1250-76
SPILLAGES FROM OIL INDUSTRY CROSS-COUNTRY PIPELINES IN WESTERN EUROPE: STATISTICAL SUMMARY OF REPORTED INCIDENTS 1974.

King. E.M. 1975.
Stichting CONCAWE Report 7. 18p.

Oil spills, Oil transport, Pipelines, Europe, Cleanup, Statistics

In cross-country pipeline systems in Europe, which total 17,350 km in length and transport 524 million m^3 of crude oil, eighteen spills were reported for 1974. The gross volume spilled was about 1950 m^3, or about 0.0004% of the total volume transported. All spills were cleaned up in generally less than a month's time, and no known pollution of potable water resources was reported.

[from Pollution Abstract 7(2): #76-2000. 1976.]

C-1251-76
THE MIZUSHIMA OIL SPILL

Nicoll, C.W. 1975.
Available Enquiry Centre, Environment Canada, Ottawa K1A 0H3.

Oil spills, Environmental effects

Summary not available.

[from UDS Water Quality Control Digest VII (2): 24. 1976.]

C-1252-76
CASE STUDY: HANNAH BARGE SPILL, MILWAUKEE, WISCONSIN

Sullivan, E.L., 1976.
Industrial Pollution Conference, 4th, Houston, Texas, 1976. McLean, Virginia, Water and Wastewater Equipment Manufacturers Association, 1976. p.LVII.

Oil spills, Fuel oil, Cleanup, Contingency planning, Great Lakes, *Lake Michigan, *Hannah Barge Spill

The coordinated response of several private, state, and federal agencies in successfully combatting a major oil spill on Lake Michigan is described. The spill occurred in adverse weather late February, 1975, and spilled nearly 300,000 liters of industrial fuel oil. The chronology of the spill event and subsequent cleanup operations are detailed. The contingency plans, personnel training, and cooperative response measures are also reviewed.

2. MONITORING

C-1253-76
ALMOST THERE - AN EFFICIENT POLLUTION MONITOR

Anon. 1975.
Marine Week 2(27):29.

Design and engineering, Pollution prevention, International conventions

The design and operating principle of an oil pollution monitoring device, which has been developed as a result of the 1973 IMCO Convention on prevention of pollution from ships, is described. Convention limitations are given and the way in which the instrument achieves the measurements required is also discussed.

[from MRIS Abstracts 12: #125984. 1976.]

C-1254-76
BALLAST DISCHARGE MONITOR / CONTROL SYSTEM FROM THE KEENE CORPORATION

Anon. 1975.
Shipping World and Ship Builder 168(3902):227.

Oil discharges, Ships, Ballast, Detection

The Fluid Handling Division of the American Keene Corporation has introduced a modular shipboard system for detecting, monitoring and controlling oily waste water. The system consists basically of a pump, a gross solids separator, and a computerized electronic monitor which records oily discharges in ppm and liters/nautical mile.

[from Pollution Abstracts 7(2): #76-01462. 1976.]

C-1255-76
INFRARED DETERMINATION OF HYDROCARBONS IN WATER (product information)

Anon. 1975.
Wilks Application Report No. 1. 22p.

Analytical methods, Hydrocarbons, Wastewater, Refineries

This report describes instrumentation, analytical procedures and calculation methods employed to determine the dissolved hydrocarbons in water. The analytical method described is based upon solvent extraction followed by infrared analysis of the extract. It provides a convenient and reliable method for monitoring the hydrocarbon content in effluent water from refineries, petrochemical plants, or drilling rigs. FFI contact, C.W. Salisbury, 140 Water St. S. Norwalk, Conn. 06856.

C-1256-76
OIL SPILL DETECTOR

Anon. 1975.
Chemical Engineering 82(22):159.

Oil spills, Detection, *Oil sensor, *Oleophilic membrane

An oil spill detection device is described which can monitor the presence of oil on land or in moving or standing bodies of water. In each device an olephilic membrane conveys any oil present to a calibrated sensor which then activates an alarm. Alarm units for a comprehensive system can monitor up to 20 different locations.

[from Selected Water Resources Abstracts 9(6):#02581. 1976.]

C-1257-76
SCIENTISTS FROM VIMS EXPLORE OUTER CONTINENTAL SHELF

Anon. 1976.
Sea Technology 17(3):33.

OCS, Environmental effects, Offshore development, Sampling, Marine organisms

The Virginia Institute of Marine Science is conducting expeditions designed to explore the Outer Continental Shelf (OCS), in an effort to provide baseline data for future analysis of environmental conditions in the event of OCS oil and gas development. Three cruises are planned, in which sample collections will be made of bottom-dwelling animals, zooplankton, and organisms inhabiting the neuston layer.

C-1258-76
WORLD HEALTH ORGANIZATION, UNEP TO ASSESS MEDITERRANEAN POLLUTION

Anon. 1976.
IMS Newsletter No. 11:1,2.

Mediterranean Sea, Sampling, Chemical analysis, International agreements

A UNEP Co-ordinated Mediterranean Pollution Monitoring and Research Programme is being conducted by 15 of the 18 Mediterranean countries. Samples have been collected and observations made of pollution on beaches and in offshore waters. Methods of measuring pollution and sample analysis were agreed upon by scientists from the participating countries in December, 1975.

C-1259-76
PELAGIC TAR FROM BERMUDA AND THE SARGASSO SEA

Butler, J.N., B.F. Morris and J. Sass. 1975.
Marine Chemistry 2(4):263-275.

Tar, Sargasso Sea, Source identification

From surveys of pelagic tar lumps in the Atlantic Ocean, it has been reported that the highest concentrations occur in the Sargasso Sea (2-40 mg/m^2). The possible sources and chemical composition of pelagic tar on Bermuda beaches and in the Sargasso Sea are discussed.

[from Marine Geology 20(2):192. 1976.]

C-1260-76
MICROBIOLOGICAL ASPECTS OF OIL INTRUSION IN SOUTHEASTERN LOUISIANA

Crow, S.A., M.A. Hood, and S.P. Meyers. 1975.
Symposium - workshop on Impact of the Use of Microorganisms on the Aquatic Environment, Pensacola Beach, Florida, 1974. Bourgin, Meyers, and Ahearn (eds.).Corvallis, Oregon, Office of Research and Development, EPA, 1975. p. 221-234. (U.S. Environmental Protection Agency Ecological Research Series EPA - 660/3-75-001.)

Microorganisms, Oil spills, Louisiana

Microbial population densities and types were monitored at the site of an oil spill in Barataria Bay, Louisiana, and in experimentally oiled marsh plots. This study shows that the presence of oil causes an increase in hydrocarbonoclastic and proteolytic microorganisms, and inhibits cellulolytic types. A greater bacterial species diversity was found in oiled areas.

C-1261-76
RELEASE OF THE CARCINOGEN BENZO(A)PYRENE FROM ENVIRONMENTALLY CONTAMINATED MUSSELS

Dunn, B. P., and H. F. Stich. 1976.
Bulletin of Environmental Contamination and Toxicology 15(4):398-401.

Carcinogens, Contamination, Molluscs, *Benzo(a)pyrene

The residence time of benzo(a)pyrene in mussels was measured using a radioactive tracer. The results indicate that these mollusks can be used as monitors for PAH and other carcinogens. However, the short depuration periods used to eliminate bacterial contamination from shellfish before marketing have only a slight effect on the tissue content of the carcinogen B(a)P in mussels. Under these conditions, the carcinogen could be a health hazard.

C-1262-76
OIL POLLUTION OF INLAND WATERS

Fielding, M. 1976.
Public Health Engineer 4(1):18-22.

Groundwater, Contamination, Detection, Sampling

The article calls for the continuous surveillance and monitoring of present and potential oil pollution of ground water resources. The effects of groundwater contamination by oil, and some current problems of identification, sampling and detection of oil pollutants are reviewed.

[from Water Research Centre Information 3(9): #76-7175. 1976.]

C-1263-76
METHOD AND APPARATUS FOR DETECTING THE DEGREE OF CONTAMINATION OF WASTE WATERS.

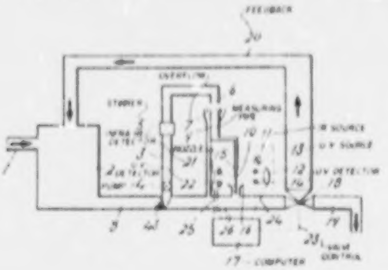
Hayashi, K., S. Serna, and I. Sakuiada. 1975.
U.S. Patent 3,917,945.

Detection, Contamination, Wastewater, *Fluorescence, *IR and UV light measurement.

The patent relates to an apparatus and process which use light projected onto a wastewater stream to continuously monitor and determine the types and relative quantities of contaminants present. Contaminants, including oil, are characterized and quantified by continuous measurement of the amount of infrared and ultraviolet light absorbed or emitted by the waste water stream. Specific oils can be identified by their unique florescence characteristics.

[from Selected Water Resources Abstract 9(7): #W76-03014. 1976.]

3,917,945
METHOD AND APPARATUS FOR DETECTING THE
DEGREE OF CONTAMINATION OF WASTE WATER
Shunzo Sema, Tokyo, and Ikuo Sakurada, Kokubungi, both of
Japan, assignors to Katsuhiki Hayashi, Tokyo, Japan
Filed June 10, 1974, Ser. No. 477,743
Claims priority, application Japan, June 21, 1973, 48-69174; Aug. 18, 1973, 48-97054[U]
Int. Cl.^{2} G01T 1/167, G01J 1/42
U.S. Cl. 250—301 14 Claims



C-1264-76
RESULTS OF AN ENVIRONMENTAL RESEARCH PROGRAM IN THE CANADIAN BEAUFORT SEA

Hnatiuk, J. 1976.
Offshore Technology Conference, 8th, Houston, 1976. Paper OTC-2445.
Abstract.

Marine Organisms, Biological effects, Oil spills, Beaufort Sea

The results of a cooperative industry government research program conducted in the Canadian Beaufort Sea in 1974 and 1975 are presented. The program has provided valuable environmental baseline data and includes studies on marine life, biological effects of oil pollution, and oil spills in ice laden waters. Ecologically sensitive areas and inadequacies in present oil spill technology are identified.

C-1265-76
METHOD AND APPARATUS FOR DETERMINING A FLUID CONTAMINANT

Hubby, L.M. 1975.
British Patent 1,418,130

Contamination, Leakage, Offshore drilling, Design and engineering

Oil contamination in runoff water from a drill rig or offshore platform can be detected with a U-tube with fixed outlet leg and a float detector on the inlet leg. Oil contamination causes the float to raise, which then triggers an alarm system.

[from Chemical Abstracts 84(16):#1113702. 1976.]

C-1266-76
OIL SPILL DETECTION SYSTEM

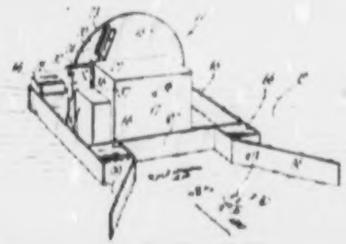
Miller, G.H., and E.O. Remick, Jr. 1975.
U.S. Patent 3,916,674

Detection, Oil spills, Design and engineering, *Oil sensor

The patent relates to a system for detecting oil floating on a body of water. The apparatus is composed basically of a stainless-steel rotating disc, and a buoyant support system equipped with a number of mechanical devices designed to (1) direct surface waters and contaminants toward the disc, (2) remove adhering contaminants from the rotating disc, and (3) bring such contaminants into contact with electrical capacitance measuring devices that signal the presence of oil.

[from Selected Water Resources Abstracts 9(6): #2996. 1976.]

3,916,674
OIL-SPILL DETECTION SYSTEM
Gordon H. Miller, Richmond, and Edward O. Renick, Jr., Sandston, both of Va., assignors to Texaco Inc., New York, N.Y.
Filed Feb. 22, 1974, Ser. No. 444,934
Int. Cl.^{2} G01N 27/22
U.S. Cl. 73—61.1 R **8 Claims**



C-1267-76
ENVIRONMENTAL ASSESSMENT OF THE ALASKAN CONTINENTAL SHELF. VOLUME 5. CHEMISTRY AND MICROBIOLOGY

National Oceanic and Atmospheric Administration. 1975.
Program Work Statement, NOAA-75122905. 120p.

Environmental effects, Alaska coast, Hydrocarbons, Microorganisms

Ten papers are included which deal with the chemistry and microbiology aspects of the waters in and around the Alaska coast. Portions of this document are not fully legible.

[from Government Reports Announcements 76(7): #PB-248 936/7GA. 1976.]

C-1268-76
MEASUREMENT OF POLLUTION AND ITS EFFECTS ON THE ENVIRONMENT

Reay, J.S.S., et al. (date unknown)
Institute of Fuel Conference, Eastbourne, United Kingdom, 1973. p.101-127.

Environmental effects, Hydrocarbons

Monitoring, the fate of pollutants, and ecological effects of pollution on the environment are topics examined. Sulfur, carbon monoxide, carbon dioxide, particulates, metals, nitrogen oxides and hydrocarbons, are discussed with respect to air and water pollution.

[from Environment Abstracts 6(2): #76-01081. 1976.]

C-1269-76
OVERVIEW: ENVIRONMENTAL BASELINE MONITORING PROGRAM, TRACTS U-a AND U-b

Ross, D. 1975.
Colorado School of Mines Quarterly 70(4):239-244.

Oil shale development, EIS, Environmental effects

The article briefly outlines the scope and nature of environmental baseline reports and detailed development plans which are being prepared by the White River Shale Project group of Colorado and Utah as part of the environmental stipulations of the federal oil shale lease program.

[from Petroleum Abstracts 16(16): #218,651. 1976.]

C-1270-76

ORIGIN AND DISTRIBUTIONS OF LOW MOLECULAR WEIGHT HYDROCARBONS IN GULF OF MEXICO COASTAL WATERS

Sackett, W.M., and J.M. Brooks. 1975.
Marine Chemistry in the Coastal Environment. T.M. Church (ed.).
Washington, D.C., American Chemical Society, 1975. p.211-230.

Chemical analysis, Hydrocarbons, Gulf of Mexico, Natural seepage, Offshore production, Oil discharges

Analysis of thousand of water samples from the Gulf of Mexico for C_1 to C_4 hydrocarbons indicates that natural seepage as a source of these hydrocarbons is negligible in comparison to man-derived inputs, especially offshore petroleum production activities. Two oil industry practices which contribute the most to C_1 to C_4 hydrocarbon pollution are the underwater venting of noncommercial gas and the discharge of brines containing soluble petroleum components.

C-1271-76

MACOMA BALTHICA: AN INDICATOR OF OIL POLLUTION

Shaw, D.G., A.J. Paul, L.M. Cheek, and H.M. Feder. 1976.
Marine Pollution Bulletin 7(2):29-31.

Biological effects, Oil slicks, Mollusks, **Macoma balthica*

In experiments which simulated stranding of an oil slick on a mudflat, it was found that the mortality of *M. balthica* increased with increasing concentration of petroleum and increasing duration of exposure. The relationship between mollusk mortality and oil concentration is believed to be a result of the animal's deposit feeding habit.

C-1272-76

POLLUTANT INPUTS AND DISTRIBUTIONS OFF SOUTHERN CALIFORNIA

Young, D.R., D.J. McDermott, T.C. Heesen, and T.K. Jan. 1975.
Marine Chemistry in the Coastal Environment, T.M. Church (ed.).
Washington, D.C., American Chemical Society, 1975. p.424. (ACS Symposium Series, 18.)

Hydrocarbons, California coast

Summary not available.

[from Current Contents, Physical and Chemical Sciences 16(6):17. 1976.]

3. REMOTE SENSING

C-1273-76
AN INFRARED REMOTE SENSING TECHNIQUE FOR IMPROVED OIL SLICK CLASSIFICATION

Gerhard, G.C., and R.L. Bolus. 1974.
New Hampshire University, UNH-SG-149. 45p.

Oil slicks, Design and engineering, *Infrared techniques

The design, construction and evaluation of an inexpensive and simple system are described. Emission and reflected radiation spectrograms are presented and inherent problems with the present system are investigated.

[from MRIS Abstracts 12:#09818. 1976.]

C-1274-76
OIL POLLUTION DETECTION AND MONITORING FROM SPACE USING SKYLAB

Goldman, G.C., and R. Horvath. 1975.
Final Report, NASA-CR 144502, Contract NAS9-13281. 44p.

Detection, Monitoring, Oil slicks, *Skylab

From experience gained in the attempted use of Skylab data for the observation of oil spills, minimum acceptable requirements of a satellite surveillance system are outlined. Daily coverage, high resolution, and a variety of spectral channels are required to effectively detect and monitor spills. At present, remote sensing data cannot detect and monitor oil slicks or spills in adverse weather or unclear water, spills less than hundrds of meter long, or those occurring nearshore or in rivers, bays and harbors.

C-1275-76
APPLICATION OF LANDSAT-2 TO THE MANAGEMENT OF DELAWARE'S MARINE AND WETLAND RESOURCES

Klemas, V., D. Bartlett, W. Philpot, and G. Dairs. 1975.
Progress report, NASA-CR-145584, Contract NAS5-20983. 7p.

Oil slicks, Estuaries, Dispersions, Movement, Delaware

Landsat imagery was used to support oil slick tracking experiments which have shown that estuarine fronts or boundaries can strongly influence dispersal and movement of oil slicks. During certain parts of the tidal cycle, frontal systems tend to capture and hold oil slicks, causing them to line up along the fronts.

[from Scientific and Technical Aerospace Reports 14(3): #12433. 1976.]

C-1276-76
VERIFICATION BY REMOTE SENSING OF AN OIL SLICK MOVEMENT PREDICTION MODEL

Klemas, V., G. Davis, and H. Wang. 1975.
NASA-CR-145596, Contract NAS5-20983. 2p.

Models, Oil slicks, Movement, Dispersions, Coasts

A model to predict oil slick movement and dispersion was verified by imagery from both Landsat satellites. The imagery provided valuable data on overall circulation patterns and coastal front systems that strongly influence the dispersion and movement of oil slicks.

[from Scientific and Technical Aerospace Reports 14(3): #12444. 1976.]

C-1277-76
APPLICATION OF LANDSAT TO IDENTIFY POTENTIAL ON-SHORE IMPACT OF OUTER CONTINENTAL SHELF DEVELOPMENT.

Klemas, V., J. Goodman, H. Lins, and D. Bartlett. 1976.
Report No. NASA-CR 146037, Contract NAS5-2983. 2p. [N76-16527]

Offshore development, OCS, *Onshore impacts, *Landsat

Landsat remote sensing data has been used in conjunction with conventional aerial photos, maps and socio-economic data to assess the potential onshore impact of offshore oil development in OCS areas off Alaska, the mid-Atlantic states, and Santa Barbara and Ventura Counties, California. No significant results are stated in this report.

C-1278-76
ENVIRONMENTAL BASELINE STUDY OF THE GULF OF ALASKA BY REMOTE SENSING

McLeod, W.R., and D.T. Hodder. 1976.
Offshore Technology Conference, 8th, Houston, 1976. Paper no. OTC-2591. Abstract.

Alaska, Gulf of, Oil spills, Movement, Spreading

Landsat land 2 imagery and other remote sensing data of the Gulf of Alaska reveal visible, progressive seasonal changes in ocean currents and sediment transport cells. This information, in conjunction with classical shipboard sampling methods, is useful in determining the transport, movement, spreading and degradation of oil spills in the Gulf.

C-1279-76
AIRBORNE SENSORS FOR MONITORING POLLUTION

Mott, P.G. 1975.
Pollution Criteria for Estuaries, Proceedings of the Conference held at the University of Southampton, 1973. P.R. Helliwell and J. Bossanyi (eds.). London Pentech Press, 1976.

Monitoring, Oil discharges, Detection

The most common types of airborne remote sensors for the monitoring and study of marine pollution are surveyed. They include conventional panchromatic air photography, color air photography, infra-red, multispectral air photography, infra-red thermal imagery and side-looking radar imagery. It has been recommended that the latter sensor system be used to continuously cover the main shipping lanes and to track oil discharges.

[from Engineering Index Monthly 14(1):#005280. 1976.]

C-1280-76
A STUDY OF A DUAL POLARIZATION LASER BACKSCATTER SYSTEM FOR REMOTE IDENTIFICATION AND MEASUREMENT OF WATER POLLUTION

Sheives, T.C. 1974.
NTIS Report N75-10563. 148p.

Models, Oil slicks, Water quality

The report discusses the use of analytical models which describe the backscatter from smooth surface turbid water for the remote identification and measurement of subsurface water turbidity and oil on water. Lidar measurements from natural waterways and ground observations of physical water quality parameters are presented and compared.

[from Environment Abstracts 6(2):#76-01456. 1976.]

4. SAMPLING

C-1281-76
REMOVAL OF WATER FROM WEATHERED PETROLEUM

Ahmadjian, M., C.D. Baer, C.W. Brown, V.M. Vestervelt. 1976.
Analytical Chemistry 48(3):628.

Crude oil, Oil-water separation, *Centrifugation

A simple and effective technique is described for the removal of water from weathered oil samples. The method is useful in field sampling because it obviates the need for solvents and high temperature treatment. Treatment consists of centrifuging and addition of small amounts of $MgSO_4$.

[from Petroleum Abstracts, 16(19): #219,369. 1976.]

C-1282-76
NONVOLATILE HYDROCARBONS ALONG TANKER ROUTES OF THE PACIFIC OCEAN

Brown, R.A., and T.D. Searl. 1976.
Offshore Technology Conference, 8th, Houston, 1976. Paper no. OTC-2448. Abstract.

Hydrocarbons, Pacific Ocean, *Tanker routes

Since 1973, Pacific Ocean routes have been sampled from the Panama Canal to Alaska, and from San Francisco to Tokyo and Singapore in order to quantify and characterize total dispersed nonvolatile hydrocarbons. Surface waters had hydrocarbon concentrations ranging from 0 to 56 ppb; subsurface waters ranged from 0 to 32 ppb hydrocarbons, with median values of 2 ppb and 1 ppb, respectively. The hydrocarbons are complex mixtures and include abundant paraffins, cycloparaffins and aromatics of probable petroleum origins.

5. ANALYSIS

C-1283-76
PAPER CHROMATOGRAPHIC ANALYSIS IN WATER POLLUTION

Aly, O.M., and S.D. Faust. 1975.
Chromatographic Analysis of the Environment. R.L. Grob (ed.).
New York, Marcel Dekker, 1975. p.489-513.

Analytical techniques, Chromatography, Hydrocarbons, Source identification

Although paper chromatography is less sensitive than thin layer chromatography, it can be a valuable analytical tool for the separation and identification of petroleum hydrocarbon pollutants in fresh and saline waters. Analytical techniques for hydrocarbons and other organics are detailed.

[from Pollution Abstracts 7(2): #76-01250. 1976.]

C-1284-76
THIN-LAYER CHROMATOGRAPHIC ANALYSIS IN WATER POLLUTION

Aly, O.M. and S.D. Faust. 1975.
Chromatographic Analysis of the Environment. R.L. Grob (ed.).
New York, Marcel Dekker, 1975. p. 511-564.

Chemical analysis, Chromatography, Detection, Source identification, Hydrocarbons

Thin layer chromatography (TLC) is an effective tool for the detection, separation and identification of organic pollutants, including hydrocarbons. Many TLC procedures were developed from analyses of wastewater and polluted surface waters; some of these techniques are detailed in this report.

[from Pollution Abstracts 7(2): #76-01249. 1976.]

C-1285-76
OCCURRENCES OF OIL AND GAS SEEPS ALONG THE GULF OF ALASKA

Blasko, D.P. 1976.
Offshore Technology Conference, 8th Houston, Texas, 1976. Paper no.
OTC-2444. Abstract.

Sampling, Chemical analysis, Natural seepage, Oil wells, Alaska, Gulf of

Onshore oil seeps and old oil wells along the Gulf of Alaska were located, sampled and analyzed to determine the types and amounts of oils or bituminous materials carried into Gulf of Alaska waters. The oils generally had low sulfur characteristics, and the amounts of bitumen and oil entering the Gulf of Alaska from onshore sources are minimal.

C-1286-76
APPLIED SPECTROSCOPY REVIEWS, VOLUME 9

Brame, Jr., E.G. 1975.
New York, Marcel Dekker, Inc., 1975. XIV+321p.

Analytical techniques, Chemical analysis, Spectroscopy, Source identification

The latest techniques and new contributions in spectroscopy are evaluated in these review articles. One of the five chapters deals with applications of infrared spectroscopy in petroleum analysis and oil spill identification.

[from Analytical Chemistry 48(3):329A-330A. 1976.]

C-1287-76
ANALYSIS OF AQUATIC MINERAL OIL POLLUTION. A PRESENTATION OF ALTERNATIVE ANALYTICAL TECHNIQUES

Carlberg, S.R. 1975.
FAO Swedish International Development Authority Training Course on Methods for Detection Measurement and Monitoring of Water Pollution, Goteborg and Stockholm, 1973. p.85-97 (FAO Fisheries Technical Paper 137.)

Chemical analysis, Chromatography, Spectroscopy, Analytical techniques

Techniques of thin layer chromatography, gas liquid chromatography, infrared spectroscopy, and ultra-violet absorption and fluorescence spectroscopy are described as possible analytical methods for the determination of aquatic mineral oil pollution. Advantages and disadvantages of each method are given.

C-1288-76
INTRODUCTION TO CHROMATOGRAPHIC METHODS WITH SPECIAL REFERENCE TO ANALYSIS OF PESTICIDES AND OIL POLLUTANTS IN THE ENVIRONMENT

Carlberg, S.R., S. Jensen, L. Renberg, and R. Vaz. 1975.
FAO Swedish Int. Development Authority Training Course on Methods

for Detection Measurement and Monitoring of Water Pollution, Goteborg and Stockholm, 1973. p.69-76. (FAO Fisheries Technical Paper 137).

Chemical analysis, Chromatography, Analytical techniques

In this paper, the different chromatographic separation techniques and the principles of these techniques are reviewed.

C-1289-76
TRACE HYDROCARBON ANALYSIS: THE NATIONAL BUREAU OF STANDARDS PRINCE WILLIAM SOUND / NORTHEASTERN GULF OF ALASK BASELINE STUDY

Chesler, S.N., B.H. Gump, H.S. Hertz, W.E. May, S.M. Dyszel, and D.P. Enagonio. 1976.
National Bureau of Standards Technical Note, NBS TN-889. 66p.

Chemical analysis, Hydrocarbons, Alaska, Gulf of, Chromatography, Spectrometry, *Baseline studies

The analytical method developed involves dynamic headspace sampling for volatile hydrocarbon components of the sample, followed by coupled-column liquid chromatography for the non-volatile components. Results of the application of this technique are presented and discussed.

C-1290-76
OCCURRENCE OF KEROSENE-LIKE HYDROCARBONS IN THE BREAM (*MYLIO AUSTRALIS*)

Connell, D.W., K. Cox, and R.L. McLauchlan. 1975.
Australian Journal of Marine and Freshwater Research 26(3):419-422.

Chemical analysis, Hydrocarbons, Fishes, **Mylio australis*, **Pomatomas saltator*

Contaminated Australian bream (*M. australis*) and tailor (*Pomatomas saltator*) were analyzed and shown to contain traces of several volatile hydrocarbons closely resembling those of commerical kerosene.

[from Chemical Abstracts: 84(15): #103950y. 1976.]

C-1291-76
COMPARISON OF ANALYSIS METHODS FOR HYDROCARBONS IN SURFACE SEDIMENTS

Farrington, J.W., and B.W. Tripp. 1975.
Marine Chemistry in the Coastal Environment. T.M. Church (ed.).
Washington, D.C., American Chemical Society, 1975. p.267-284. (ACS Symposium Series, 18.)

Chemical analysis, Analytical techniques, Chromatography, Hydrocarbons, Sediments

Three chemical extraction procedures were compared by gravimetric analysis for their efficiency in extracting hydrocarbons from marine sediment samples and were found to be similarly effective. The extracted hydrocarbons were characterized and quantified by gas chromatography. A number of samples were spiked with 10 ppm of No. 2 fuel oil, and gas chromatography was found to be useful in detecting and quantifying the spike.

C-1292-76
DEVELOPMENT OF A PROCEDURE FOR THE DETERMINATION OF HYDROCARBONS IN WATERS (English summary)

Golden, J., P. Chambon, and J. Vial. 1976.
Techniques et Sciences Municipales 71(1):17-20.

Analytical techniques, Hydrocarbons, Solvents, Chromatography, Spectroscopy

An analytical technique is described for separating hydrocarbons in water into three groups: C_{5-10} aliphatic and short chain aromatic hydrocarbons, C_{10-32} aliphatic hydrocarbons, and polycyclic hydrocarbons. Procedures used for the further identification of individual hydrocarbons within these three groups are also presented.

[from Water Research Center Information 3(11):#76-832S. 1975.]

C-1293-76
HYDROCARBON DETERMINATION IN WASTE WATERS BY MEANS OF CHANNEL THIN LAYER CHROMATOGRAPHY (English summary)

Goretti, G., A. Liberti, and B.M. Petronio. 1974.
Annali de Chimica (Rome) 64(9/10):653-658.

Chemical analysis, Wastewater, Chromatography, Hydrocarbons

Channel thin layer chromatography (TLC) is useful in the direct determination of hydrocarbons in wastewater. The analytical method for separating hydrocarbons from fats and other organic compounds and directly determining their concentration is outlined.

[from Biological Abstracts 61(10):#57639. 1976.]

C-1294-76
PACKED HIGH-PERFORMANCE GC-COLUMNS (ABOUT 50,000 HETP) FOR PROFILE ANALYSIS OF CARCINOGENIC POLYCYCLIC AROMATIC HYDROCARBONS IN FOOD,

MINERAL OIL PRODUCTS, VEHICLE EXHAUST-AND CIGARETTE SMOKE CONDENSATE ETC.

Grimmer, G., H. Boehnke, and A. Hildebrandt. 1976.
Fresenius Zeitschrift fur Analytische Chemie 279(2):139-140.

Analytical techniques, Chromatography, Hydrocarbons, Carcinogens

"A new packed glass column for gas chromatography with high separator effect is described for the determination of polycyclic aromatic hyrocarbons from a variety of sources."

[from Chemical Abstracts 84(23): #160196f. 1976.]

C-1295-76
QUANTITATIVE ANALYSIS OF PETROLEUM OIL POLLUTANTS BY INFRARED SPECTROPHOTOMETRY

Gruenfeld, M. 1975.
American Society for Testing and Materials, Special Technical Publication no. 573. p.290-308.

Analytical techniques, Crude oil, Fuel oil, Spectrometry, *Infrared spectrophotometry

The paper reports the accuracy and sensitivity of infrared spectrophotometry for the quantitative determination of petroleum oils by single point analysis. Four different representative oils, including two fuel oils and two crude oils were tested; and carbon tetrachloride and Freon 113 were compared as solvents. A concentration of 0.05 mg oil/100 ml solvent is considered the practical detection limit of these oils by the infrared spectrophotometry method.

C-1296-76
LABORATORY BIOLOGICAL STUDIES: MAKING THEM APPROPRIATE FOR PREDICTING THE EFFECTS OF OFFSHORE OIL AND GAS OPERATIONS

Hester, F.J. 1976.
Offshore Technology Conference, 8th, Houston, 1976. Paper no. OTC-2524. Abstract.

Analytical techniques, Biological effects, Hydrocarbons, Marine organisms, Offshore production

This paper critically examines fifteen well known laboratory studies on the effects of petroleum hydrocarbons on marine organisms, with emphasis on the appropriateness of their data analyses and interpretations, correctness of experimental design, and their applicability to the marine environment.

C-1297-76
IDENTIFICATION OF SPECIFIC ORGANIC COMPOUNDS IN A HIGHLY ANOXIC SEDIMENT BY GAS CHROMATOGRAPHIC MASS SPECTROMETRY AND HIGH RESOLUTION MASS SPECTROMETRY

Hites, R.A., and W.G. Biemann. 1975.
Analytical Methods in Oceanography Symposium, Atlantic City, 1974. T.R.P. Gibb, Jr. (ed.). Washington, D.C., American Chemical Society, 1975. p.188-201. (Advances in Chemical [sic] Series, No. 147.)

Chemical analysis, Hydrocarbons, Sediments, Rivers, Chromatography, Spectrometry

Sediment analysis of the Charles River Basin was conducted using gas chromatographic - mass spectrometry and high resolution mass spectrometry. A number of aliphatic and olefinic hydrocarbons, sulfur, and two esters were identified. Polycyclic aromatic hydrocarbons were the most abundant, and four sources of hydrocarbon input were cited: petroleum, incomplete combustion, biosynthesis and chemical dehydrogenation.

[from Bioresearch Index 12(5): #39091. 1976.]

C-1298-76
GAS CHROMATOGRAPHIC - MASS SPECTROMETRIC IDENTIFICATION OF ORGANIC COMPUNDS IN A RIVER WATER.

Ishiwatari, R., and T. Hanya. 1974.
Advances in Organic Geochemistry 1973. B. Tissot, and F. Bienner (eds.). Paris, France, Editors Technip, 1974. p.1052-1065.

Analytical techniques, Chromatography, Spectrometry, Hydrocarbons, Rivers

A water sample taken from the polluted Tamagawa River, Japan, was analyzed for organic components using a combined gas chromatography - mass spectrometry technique and apparatus. Of 300 organic compounds detected, 60 could be identified and included numerous aliphatic and aromatic hydrocarbons, fatty acids, esters, and sterols.

C-1299-76
GAS CHROMATOGRAPHIC ANALYSIS IN WATER POLLUTION

Jacobson, B.S. 1975.
Chromatographic Analysis of the Environment. R.L. Grob (ed.). New York, Marcel Dekker, 1975. p.399-427.

Analytical techniques, Chromatography, Hydrocarbons, Detection

Gas chromatography is evaluated as a tool for the characterization and quantitation of organic materials, including petroleum products, present at microgram to picogram levels in water samples. Analytical techniques are reviewed, and accuracy and detection limits are discussed.

[from Pollution Abstracts 7(2):#76-01247. 1976.]

C-1300-76
SYSTEMS CHEMICAL ANALYSIS OF PETROLEUM POLLUTANTS

Kawahara, F.K., and Y.Y.Yang. 1976.
Analytical Chemistry:48(4): 651-655.

Chemical analysis, Source identification, Oil spills, *Infrared spectrophotometry, *Discriminant analysis

Infrared spectrophotometric analysis with discriminant analysis was used to correctly characterize and identify 99% of several known and unknown petroleum samples. Unknown samples included weathered crude oils, heavy residual fuel oils, and asphalts, The same techniques are applicable to source identification of oil spills.

C-1301-76
AQUEOUS SOLUBILITIES OF WEATHERED NORTHERN CRUDE OILS

Mackay, D., and W.Y. Shiu. 1976.
Bulletin of Environmental Contamination and Toxicology 15(1):101-109.

Crude oil, Solubility, Chemical analysis

The aqueous solubility of crude oil decreases considerably as the more volatile and soluble hydrocarbons evaporate. Gas stripping with helium is found to be the best method for determining the solubilities of hydrocarbons more volatile than naphthalene. For the less volatile hydrocarbons in crude oil, the extraction - evaporation method is more effective.

C-1302-76
CHROMATOGRAPHIC ANALYSIS OF HYDROCARBONS IN MARINE SEDIMENTS AND SEAWATER

May, W.E., S.N. Chesler, S.P. Cram, B.H. Gump, H.S. Hertz, D.P. Enagonio and S.M. Dyszel. 1975.
Journal of Chromatographic Science 13:535-540.

Chemical analysis, Chromatography, Hydrocarbons, Sediments, Seawater, Sampling

The analytical method developed involves dynamic headspace sampling for volatile hydrocarbon components of the sample, followed by coupled-column liquid chromatography for the non-volatile components. Results of the application of this method to the analysis of samples from sites of known level hydrocarbon contamination are presented and discussed.

C-1303-76
RISK ANALYSIS AND OIL SPILL EXPECTATION FOR DEEPWATER PORTS

Moser, A.W., M.P. Noel, and J.M. Heckard. 1976.
Offshore Technology Conference, 8th, Houston, 1976. Paper no. OTC-2450. Abstract.

Statistical analysis, Oil spills, Ports, Tankers, Environmental effects, Models

A statistical analysis of recent oil spill data was conducted to assess the potential environmental risk from oil spills at two gulf coast superport locations. At present, tankers spill about 161 ppm of the oil shipped. Operating conditions of the two proposed superports can be expected to reduce tanker spillage to a range between 0.2 and 2 ppm of oil shipped. Possible environmental effects of spills are explored, and an oil spill trajectory model was developed and used to evaluate the possibility of oil striking land at any particular location.

C-1304-76
DETERMINATION OF POLYCYCLIC AROMATIC HYDROCARBONS IN WHITE PETROLEUM PRODUCTS

Popl, M., M. Stejskal, and J. Mostecky. 1975.
Analytical Chemistry 47(12):1947-1950.

Analytical techniques, Chromatography, Spectrometry, Aromatic hydrocarbons, Carcinogens

White petroleum products contain carcinogenic polycyclic aromatic hydrocarbons (PAH) in the parts per billion range, along with some S and polar compounds. The chromatographic and spectrometric techniques used to separate and identify PAH from these products are described.

[from Biological Abstracts 61(7): #38685. 1976.]

C-1305-76
FLUORESCENCE MEASUREMENTS OF BENZENE, NAPHTHALENE, ANTHRACENE, PYRENE, FLUORANTHENE, AND BENZO[E]PYRENE IN WATER

Schwarz, F.P., and S.P. Wasik. 1976.
Analytical Chemistry 48(3):524-527.

Chemical analysis, Aromatic hydrocarbons, *Aquatic systems, *Spectrofluorimetry

Flourescence spectra, quantum yields, and concentration dependencies were measured for five representative polycyclic aromatic hydrocarbons (PAH) in water to determine the applicability of spectrofluorimetry in measuring PAH in aquatic systems. Results suggest that PAH in heavily polluted water near industrial sources can be detected by this technique.

C-1306-76
ORGANIC MATERIAL OF RECENT CHESAPEAKE BAY SEDIMENTS

Shimoyama, A., and C. Ponnamperuma. 1975.
Geochemical Journal 9(2):85-95.

Chemical analysis, Sampling, Sediments, Oil spills, Chesapeake Bay.

Sediment samples from freshwater, brackish and marine environments were analyzed for various organic components and their distributions. Samples from a recent oil spill in the vicinity of Chesapeake Bay exhibited a molecular distribution pattern different from those found in the Bay sediments.

[from Biological Abstracts 61(9): #47815. 1976.]

C-1307-76
DETERMINATION OF ALIPHATIC AND AROMATIC HYDROCARBONS IN MARINE ORGANISMS

Warner, J.S. 1976.
Analytical Chemistry 48(3):578-583.

Chemical analysis, Hydrocarbons, Marine organisms, Chromatography, Spectrometry

A simple and reliable method is detailed for determining aliphatic and aromatic hydrocarbons in concentrations as low as 0.1 to 10 micrograms/gram. The hydrocarbons are first extracted, then separated, analyzed, and identified using silica gel and gas chromatography and chemical ionization mass spectrometry.

[from Petroleum Abstracts 16(19):219,366. 1976.]

6. SOURCE IDENTIFICATION

C-1308-76
GC HELPS TRACE OIL SPILLS

Anon. 1976.
Industrial Research 18(3):C1-C2, C4, C6.

Oil spills, Analytical techniques, Chromatography, Spectroscopy, Sampling

The U.S. Coast Guard's Research and Development Center has developed a comprehensive oil spill source identification system that includes analytical methods, sampling methods, sample transmittal, chain of custody and record keeping. The basic analytical methods include gas chromatography (GC), thin-layer chromatography, and infrared spectroscopy, aided in special cases by atomic absorption spectroscopy, x-ray fluorescence spectroscopy, and HPLC. Other techniques are currently being developed.

[from Petroleum Abstracts 16(15): #218,374. 1976.]

C-1309-76
TO PROFILE AND RAPIDLY DETERMINE WHETHER A SPILLED OIL SAMPLE MATCHES A SUSPECTED SOURCE (news brief)

Anon. 1976.
Environmental Science and Technology 10(5):412.

Oil spills, Spectrometry, *Spectrophotometry

The U.S. Coast Guard is testing a double-beam spectrophotometer at its Groton, Connecticut Laboratory. The Perkin-Elmer instrument offers an accurate and positive identification of an oil spill sample.

C-1310-76
OIL SPILL IDENTIFICATION

Bentz, A.P. 1976.
Analytical Chemistry 48(6):454A-470A.

Oil spills, Oil slicks, Analytical techniques, Weathering, Sampling

The various analytical approaches to the accurate identification of oil spills are presented. Discussions of the weathering of spilled oil in the marine environment and the importance of sampling methods in the oil identification process are included. As no single analytical method has yet been established as fully characterizing an oil, a multiparameter approach to oil spill fingerprinting is favored.

C-1311-76
SOURCE IDENTIFICATION OF FUEL OIL SPILLS

Berg, O.W., P.L. Diosady, R.L. Gutteridge, A.A. Nicholson, and H.L. Vanesche. 1974.
Conference on Great Lakes Research, 17th, Hamilton, Ontario, Canada, 1974. Part 1. p.483-492.

Oil spills, Fuel oil, Chemical analysis, Spectrometry, Chromatography

Ultraviolet, infrared and fluorescence spectrometry, and gas chromatography were evaluated for fingerprinting fuel oil spills. Only gas chromatography, used with a sulfur-sensitive flame photometric detector, was capable of identifying different brands of fuel oil that had weathered for over twenty-four hours.

C-1312-76
SOURCES, SINKS, CONCENTRATIONS AND SUBLETHAL EFFECTS OF LIGHT ALIPHATIC AND AROMATIC HYDROCARBONS IN THE GULF OF MEXICO

Brooks, J.M. 1975.
Ph.D Thesis, Texas A and M University, College Station. 362p.

Hydrocarbons, Gulf of Mexico, Sampling, Offshore production, Natural seepage

The spatial distribution and sources of light hydrocarbons in the Gulf of Mexico were evaluated by sampling 300 sites in the Gulf with a hydrocarbon "sniffing" apparatus. Offshore production and transportation are the chief hydrocarbon inputs for coastal waters, followed by coastal contributions from refineries and runoff. Natural seepages were found to be locally important inputs of hydrocarbons.

[from Chemical Abstracts: 84(14):#95409m. 1976.]

C-1313-76
WEATHERED PETROLEUM: ADVANTAGES OF USING INFRARED SPECTROSCOPY FOR IDENTIFICATION

Brown, C.W., F.F. Lynch, M. Ahmadjiian, and C.D. Baer. 1975.
American Laboratory 7(12):59-66.

Oil spills, Chemical analysis, Spectroscopy

Infrared spectroscopy can effectively fingerprint the relatively stable, high-boiling point components of crude oils and is therefore a method suitable for identifying the source of weathered oil slicks or oil spills.

[from Chemical Abstracts 84(14): #92407y. 1976.]

C-1314-76
A GAS LIQUID-GAS SOLID CHROMATOGRAPHIC METHOD FOR THE IDENTIFICATION OF SOURCES OF OIL POLLUTION

George, A.E., G.T. Smiley, D.S. Montgomery, and H. Sawatzky. 1975.
American Society for Testing and Materials, Special Technical Publication No. 573. p.271-289.

Crude oil, Chemical analysis, Chromatography

The article describes a new two-step gas chromatographic petroleum fingerprinting technique that is applicable to the identification of crude oils. The method provides rapid, highly characteristic fingerprints of good resolution, and it has the advantage of being capable of dealing with heavy, residual, high boiling point oils.

[from Bibliography and Index of Geology 40(1):7. 1976.]

C-1315-76
IDENTIFICATION OF CRUDE OILS BY SYNCHRONOUS EXCITATION SPECTROFLUORIMETRY

John, P. and I. Soutar. 1976.
Analytical Chemistry 48(3):520-524.

Chemical analysis, Oil spills, *Fluorimetry

Various factors influencing the use of the synchronous excitation fluorimetry technique for fingerprinting oil spills are evaluated and discussed. The technique shows great promise as a diagnostic tool for the conclusive identification of unweathered crude oil spills because of the enhanced details of the spectra produced by this method.

[from Chemical Abstracts 84(16): #18096j. 1976.]

C-1316-76
TRACE ORGANIC COMPONENTS AS FINGERPRINTS IN GAS CHROMATOGRAPHIC IDENTIFICATION OF SPILLED ASPHALTS

Kawahara, F.K. 1976.
Environmental Science and Technology 10(7).

Chemical analysis, Chromatography, *Asphalts

Weak acids, mercaptans, and phenols are shown to be effective in fingerprinting heavy petroleum oils by using a new derivative preparation followed by electron capture detection-gas chromatography. Infrared and carbon-hydrogen analyses were also employed to verify the source of the asphalt.

C-1317-76
RECOGNITION AND QUALITATIVE CHARACTERIZATION OF COMMERCIAL PETROLEUM FUELS BY A GAS CHROMATOGRAPHIC FINGERPRINTING TECHNIQUE.1. GENERAL CONSIDERATIONS

Petrovic, K., and D. Vitorovic. 1976.
Journal of Chromatography 119(1):413-422.

Fuels, Analytical techniques, Chromatography

A simple gas chromatographic fingerprinting technique is described for the rapid source identification and qualitative characterization of pollutant petroleum products, such as fuel oils, diesel fuels, and gasoline and jet fuels. Advantages of the method are short analysis time, good repeatability, and additional, secondary information on fuel characteristics and quality.

B. OIL POLLUTION PREVENTION AND CONTROL

1. CONTAINMENT

C-1318-76
No title given (news brief)

Anon. 1976.
Ocean Industry 11(4):55.

Booms, Oil spills, Wastewaters

"Oil boom developed by Oy Nokia Ab has been designed for rapid transport and easy installation. The booms, as part of a range of oil pollution control equipment, may also be used to protect beaches or for guiding industrial wastewaters to a sheltered inlet for treatment. For industrial wastes, the boom is increased until it reaches the sea or lake bed. Guiding booms are up to 4 m high."

C-1319-76
BOOM PERMANENTLY CONTAINS OIL, DEBRIS (product information)

Anon. 1976.
Oil and Gas Journal 74(18):279.

Booms, Oil slicks, Design and engineering

The Seaboom is made of connected panels, each 7 m long, made of 13 mm thick vinyl, and reinforced with rib handles of urethane. It is designed to be kept in water. One portion is attached to an existing structure; another portion can enclose a ship. FFI contract B.F. Goodrich Engineered Systems Co., 430 South Main, Cohassett, Mass. 02025

C-1320-76
BUBBLE BARRIER TRAPS LOADING SPILLS (news brief)

Anon. 1976.
Ocean Industry 11(4):55.

Oil spills, Harbors, Oil tranfer, *Bubble barrier

"Bubble Barrier, installed by Atlas Copco at the Fredrikskans oil harbor, Gavle, Sweden, uses compressed air forced through a hose 2 m below the surface to retain oil spilled during loading operations at the harbor. The oil is kept within a small area and can be easily removed by oil spill cleanup equipment. The installation will retain 800 m^3 of oil with no wind, or 150 m^3 with a wind velocity of 32 km/hr."

C-1321-76
TRANSFORMER PIT LINER HOLDS OIL SPILLS

Anon. 1976.
Electrical Construction and Maintenance 75:80.

Oil spills, Inland, Design and engineering, *Tranformer coolant oil

A method of containing an accidental spill of transformer coolant oil from a ruptured case has been developed by Commonwealth Edison Company, Chicago. The design includes the use of a well or pit filled with rocks to accept the spilled fluid and prevent it from seeping into the ground, contaminating water, storm drains. etc.

C-1322-76
TREATMENT OF OILS SPILLED ON WATERS

Baba, T., T. Sato, and M. Kamei. 1975.
Japanese kokai (unexamined patent application) 75,117,686.

Oil spills

"The area of an oil spill on water is reduced by applying $R^3(CH_2)_n$ $SO_2NR^1R^2$, or $R^3(CH_2)_n$ $CONR^1R^2$ ($R^1=C_{1-7}$ hydroxalkyl or alkozyalkyl; R^2 = H or C_{1-6} alkyl; n = 0-3)."

[from Chemical Abstracts 84(14):#95304y. 1976.]

C-1323-76
OIL CONTAINMENT BOOM

Bennett, J.A., and I.R. McAllister. 1975.
U.S. Patent 3,924,412

Booms, Design and engineering

This patent relates to a floating, elongate, skirt-like barrier which is adpated to float so that its upper edge is continuously above the water surface. Pairs of floats are attached to the flexible barrier at regularly spaced intervals by means of special tongue and groove connecting devices. These devices permit moderate elongation of the barrier (under tension) without undue wear of the connecting portions.

[from Petroleum Abstracts 16(13):#217,920.]

C-1324-76
FLOATING OIL SCREEN

B.F. Goodrich Company. 1975.
Netherlands Application 7,503,569

Oil slicks, Design and engineering, *Oil screen

This invention is a floating oil screen for the containment of oil on water. The screen can be raised or lowered to pass ships by means of elements mounted on opposite sides of the sheet-like screen. These elements keep the screen in the proper position when the barrier is floating or in an underwater position.

[from Petroleum Abstracts 16(12): #217,701. 1976.]

C-1325-76
THE ANALYSIS OF A CONTAINED EMULSIFIED OIL SLICK

Collins, D.J., G.D.M. MacKay, and K.T. Wong. 1976.
Offshore Technology Conference, 8th, Houston, 1976. Paper no. OTC-2694. Abstract.

Booms, Oil slicks, Emulsions

This paper describes the performance of an oil containment boom for holding emulsified oil slicks. Unlike typical viscous oil slicks, which are Newtonian fluids, many emulsified oil slicks are Bingham Plastics in character, and thus behave differently during containment. For example, emulsified oil slicks can be contained within a boom at much greater velocities than viscous oil slicks.

C-1326-76
LABORATORY EVALUATION OF OIL HERDERS

Nagy, E. 1974.
Water - 1974: I. Industrial Wastewater Treatment. G.F. Bennett (ed.). New York, American Institute of Chemical Engineers, 1974. p. 243-246. (AIChE Symposium Series, Vol. 70, no. 144.)

Oil slicks, Crude oil, *Oil herders

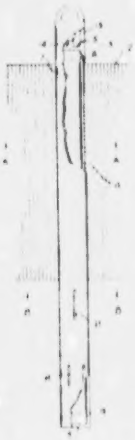
Oil herders are surfactant membranes that either prevent the spreading of oil films or compress thin oil films into thicker oil lenses. This paper reports on a laboratory method which evaluates the effectiveness of commerical oil herders when used on refined or fresh and weathered crude oils.

C-1327-76
OIL SPILL CONTAINING BOOM

Neal, J.H. 1975.
U.S. Patent 3,921,407

The boom is a floating barrier consisting of an oil-containing mesh material stretched between spaced vertical spars. The spars are weighted and constructed to automatically rise into vertical position in water. The boom is light, can be stored on a reel, and is readily deployed around a spill.

[from Petroleum Abstract 16(11):#217,417. 1976.]



C-1328-76
FLOATING OILFENCE

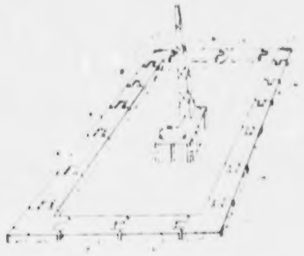
Pocke, J.M. 1975.
U.S. Patent 3,925,991

Booms, Design and engineering

A floating barrier capable of containing oil on any large body of water is described. The barrier consists of interlocking pontoons which are connected by extremely flexible, sealed couplings that permit vertical, horizontal, lateral and longitudinal movement without allowing oil to seep out between the pontoons. The pontoons can be used to store the oil until pickup by other vessels.

[from Petroleum Abstracts 16(13):#217,921. 1976.]

3,925,991
FLOATING OIL FENCE
John M. Poche, 6317 Franklin Ave., New Orleans, La. 70122
Filed July 24, 1974, Ser. No. 491,522
Int. Cl.² E02B *15/04*
U.S. Cl. 61—1 F **12 Claims**



C-1329-76

APPARATUS AND METHOD FOR PRODUCING AIR BUBBLE IN A BODY OF LIQUID

Schramm, H.J. and J.R. McCullough. 1976.
Canadian Patent 982,448

Oil slicks, Design and engineering

The effectiveness of air barriers in confining surface water pollutants depends largely on the uniformity of air pressure in a perforated bubbler hose. An auxiliary distributin conductor carries the air under high pressure and transmits it via a number of spaced interconnections to the bubbling hose, which is provided with pressure regulators.

[from Petroleum Abstracts 16(12):#217,697. 1976.]

C-1330-76

FLOATING BOOM HAVING ROTATABLE FLOAT ELEMENTS

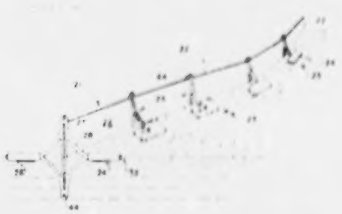
Tanksley, N.D. 1975.
U.S. Patent 3,922,860

Booms, Oil spills, Design and engineering

A floating barrier for the containment of oil and other floating pollutants is described. The boom consists of an elongate sheet-like partition and floats mounted at intervals over its length. The floats include plate like float elements which can rotate about a horizontal axis to and from a deployed position. The boom is foldable and forms a compact unit, capable of rapid deployment when needed.

[from Petroleum Abstracts 16(12):#217,698. 1976.]

3,922,860
FLOATING BOOM HAVING ROTATABLE FLOAT ELEMENTS
Neeld D. Tanksley, Walnut Creek, Calif., assignor to Pacific Pollution Control, Emeryville, Calif.
Filed Sept. 30, 1974, Ser. No. 510,290
Int. Cl.² E02B *15/04*
U.S. Cl. 61—1 F **10 Claims**



2. CLEANUP AND RECOVERY

C-1331-76
AGGLOMERATION OF OIL BY PETROLEUM PROTEINS

Abe, K., S. Tomita, Y. Matsuda, K. Terashima, and Y. Ando. 1975.
Japanese Kokai (unexamined patent application) 75 40,485

Oil spills, Cleanup, *Agglomeration

An oil-agglomerate-forming agent to treat oil spills on water is prepared from petroleum proteins and, optionally, an equal amount of water-soluble high-molecular weight acids or alcohols. The formed oil agglomerates are collected and disposed.

[from Chemical Abstracts 84(10): #65009p. 1976.]

C-1332-76
CLEANUP OF INLAND OIL SPILLS

Agius, P.J., H. Jagger, D.R. Fussell, and G.L. Johnes. 1975.
World Petroleum Congress, 9th, Tokyo, 1975. Vol. 6. p. 297-304.

Cleanup, Oil spills, Inland, Contingency planning

A knowledge of probable sources, size of spills, and their behavior under different conditions greatly effects spill cleanup. Prior planning and preparation, coordination of efforts, and provision of cleanup kits are stressed in dealing with oil spillage.

[from Petroleum Abstracts 16(20): #219,580. 1976.]

C-1333-76
No title given (news brief)

Anon. 1976.
Offshore 36(5):415.

Cleanup, Pollution prevention, OCS, Arctic, Bibliographies

In conjuction with the University of Alaska Agricultural Experiment Station, Arctec Inc., of Columbia, Maryland, will survey and evaluate existing OCS pollution equipment and its suitability for arctic environments. The research includes a compilation of literature on effects and control of oil pollution in arctic to subarctic regions.

C-1334-76
AN OIL SPILL RECOVERY SYSTEM (news brief)

Anon. 1976.
Environmental Science and Technology 10(2):117.

Oil spills, Recovery, Absorption

The system is designed to pick up nearly 190,000 l/hr of oil and can operate in seas resulting from wind velocities as high as 45 km/hr. The invention uses 3.6 million chips/hr. of polyurethane foam. Chips are sprayed on an oil spill, collected, and squeezed dry and reused. The Navy Civil Engineering Laboratory expects that the system will be available for open-sea cleanup by early 1977.

C-1335-76
BLANKET SOAKS UP OIL SPILLS; MICROBE CONVERTS THEM INTO FISH FOOD

Anon. 1975.
Machine Design 47(Oct. 16):4.

Oil spills, Cleanup, Absorption, Biodegradation, Microorganisms

Owens - Corning Fiberglas Corp. has developed a floating absorbent fiberglas blanket called Glasorb, which can absorb up to 40 times its weight in oil. Dr. A.M. Chakrabarty of the GE Research and Development Center has genetically engineered a "supermicrobe" which biodegrades oil at several times the rate of any other organism, and converts it to protein-rich food.

C-1336-76
CAN PHOTOSYNTHESIS DESTROY OIL SPILLS? (news brief)

Anon. 1976.
Chemical Engineering 83(5):65.

Oil spills, Cleanup, *Photosensitizer chemicals

Germany's Batelle Institut e.V. (Frankfurt/Main) is evaluating the effectiveness of photosensitizer chemicals in destroying oil films on water. As many as 40 photosensitizers will be screened. Environmental effects of the chemicals will not be studied until leading compounds are selected.

C-1337-76
CONTINUOUS SWEEPS RETRIEVE FLOATING OIL (product information)

Anon. 1976.
Oil and Gas Journal 74(14):161.

Recovery, Oil spills, Absorption, Design and engineering

Continuous sweeps can absorb up to 22 times their weight in recovered oil and remain afloat when fully saturated. Each sweep is 30 m long, 0.5 m wide and 6 mm thick, weighs about 5.7 kg, and can be quickly unrolled and spread across the water surface. FFI contact Conwed Corporation, 332 Minnesota St., St. Paul, Minnesota 55101.

C-1338-76
DISPERSING OIL IN WATER WITH ALKYDS CONTAINING POLYALKYLENE GLYCOL

Anon. 1975.
Belgian Patent 824-514

Dispersants, Cleanup, Pipelines, Wastewater treatment

The method described is effective in dispersing oil on water, secondary recovery processes, recovering oil from tar sands, and cleaning of pipelines and tank linings. Once dispersed by the process, the oil droplets do not readily combine.

[from Selected Water Resources Abstracts 9(6):#74-02583. 1976.]

C-1339-76
ENVIRONMENTAL PROTECTION AT SEA (news brief)

Anon. 1976.
Ocean Industry 11(4):170.

Cleanup, Oil spills, Harbors, Japan

The Japanese Maritime Safety Agency has established a program of cleaning up oil-contaminated sea water in partially enclosed sea areas such as Tokyo Bay, Osaka Bay, Inland Sea, and the Waters of Ariake. In addition, the agency has been promoting the development of equipment for preventing and cleaning up large oil spills.

C-1340-76
EXISTING METHODS CAN CLEAN SOME ARCTIC SPILLS

Anon. 1976.
Oil and Gas Journal 74(13):78.

Oil spills, Arctic, Detection, Cleanup, Disposal

According to Arctec Inc., Columbia, Maryland, certain types of fuel and crude oil spilled in marine areas with broken ice can be recovered with existing methods and equipment. Artec is presently researching and evaluating available information on detection, containment, recovery, transfer, storage, and disposal equipment for possible usefulness in Arctic and subarctic regions.

C-1341-76
IMBIBER BEADS NOW USED TO SOAK UP OIL SPILLS (product information)

Anon. 1976.
Petroleum Marketer(March April 76):9,25-27.

Recovery, Oil spills, Absorption

Imbibitive polymer beads have the capacity to soak up 27 time their own volume in oil. They can be used in ocean oil spills, oil refineries, manufacturing plants and service station pumps and tanks. FFI contact Gedor Environmental Protection Corporation, 1313 South Newburgh Road, Westland, Michigan, 48185.

C-1342-76
LOCKHEED OIL SKIMMER WILL BE USED IN BEAUFORT SEA (news brief)

Anon. 1976.
Ocean Industry 11(4):370.

Oil spills, Recovery, Skimmers, Beaufort Sea, Design and engineering

The Lockheed Clean Sweep oil skimmer is a craft specially designed for operation in artic ice-laden waters. It features a high-capacity space heater to warm the oil collection trough and a tumbler bar which submerges the encountered floating ice chunks and shoves them behind the craft. The unit is designed to recover 200 liters of oil per minute and is equipped with storage pontoons.

C-1343-76
METHOD FOR CLEANING HIGH SEAS OIL SPILLS

Anon. 1976.
Ocean Industry 11(5):151.

Oil spills, Recovery, Oil-water separation, Skimmers

A new ocean-going oil spill recovery ship, the Ocean Oil Scooper, has been developed by Trygve Thune A/S of Oslo, Norway. When in operation, two doors in the ship's square bow open to form a scoop, and the vessel passes through the oil slick at a speed of 6.5 km/hr., recovering oil at a rate of up to 420 metric tons/hr. (460 tons/hr.) assuming an oil film of 5 mm thickness. The ship has oil-water separation equipment and storage tanks for several hundred tons of recovered oil.

C-1344-76
MOP INVENTION AIDS RECOVERY OF SPILLED OIL (product information)

Anon. 1976.
National Fisherman 57(2):7B.

Recovery, Oil spills, Absorption, Design and engineering

Oil mop, consisting of plastic feather-like strands fused on a plastic rope and a wringer, has been developed for small and medium size oil spills. The oil is soaked up by the feather strands which are then squeezed by the wringer to recover the oil. FFI contact: Oil Mop Inc., Belle Chasse, Louisiana 70037.

C-1345-76
NAVY OIL-SPILL SYSTEM PICKS UP 1,000 BARRELS-PER-HOUR

Anon. 1976.
Offshore 36(4):121-122.

Oil spills, Recovery, Absorption, *Polyurethane chips

The Navy oil-spill recovery system uses 3.6 million polyurethane foam chips an hour to absorb a spill. Recovery involves four steps: spraying chips across a 6 m wide oil path, guiding the chips onto a collecting belt, squeezing the chips "dry" of oil, and returning the chips to the system for reuse. Successful open-sea tests have been conducted in rough waters with 1.2 m waves.

C-1346-76
NEW 12 OZ. ABSORBENT CATCHES 30 LBS. OF OIL (product information)

Anon. 1976.
Oil and Gas Journal 74(11):136-137.

Recovery, Absorption, Oil slicks

Petro-Trap is a floating absorbent pad which absorbs oil but lets water pass by its rugged outer jacket. When the pad is saturated, the oil can be wrung out and the absorbent is ready for reuse. The device will not sink. FFI contact Petro-Trap, P.O. Box 157, Westport, Massachusetts 02790.

C-1347-76
NEW SKIMMER VERSION IS RADIO CONTROLLED (product information)

Anon. 1976.
Oil and Gas Journal 74(20):254.

Skimmers, Recovery, Oil slicks, Refineries

Lockheed's Clean Sweep oil skimmer, a radio controlled device, operates on the principle that oil adheres to a metal surface and water runs off. Powered hydraulically by an onboard 25 hp. diesel engine, the 0.6 m diameter, 1.2 m long Clean Sweep drum recovers about 150 liters/m. It is designed for refinery ponds. FFI contact Lockheed Missiles and Space Co. Inc., Box 504, Bldg. 10, Sunnyvale, California 94088.

C-1348-76
NOVEL OIL SKIMMER CONCEPT (product information)

Anon. 1976.
Ocean Industry 11(4):240.

Skimmers, Recovery, Oil spills, Design and engineering

A new oil recovery device, called the Inclined Plane Oil Skimmer, has been developed by the Mitsui Ocean Development and Engineering Company, Ltd. The device is built into the hull of a vessel, has no moving parts and needs no maintenance. Oil is channeled along an inclined plane into a well in the vessel from where it is pumped into storage tanks.

C-1349-76
OIL SPILL ABSORBANT (product information)

Anon. 1976.
Pollution Engineering 8(5):67.

Cleanup, Oil spills, Absorption

Sorb-Oil absorbs many times its own weight of hydrocarbons. Designed for use in drains, drift tanks and oil handling areas, it is available in mats, booms and chips. FFI contact: Ling Products, Inc., Environmental Division.

C-1350-76
OFFSHORE PATROL CRAFT WITH BUILT IN OIL SKIM SYSTEM (news brief)

Anon. 1976.
Oil and Gas Journal 74(17):184.

Oil spills, Recovery, Containment, Design and engineering

A modular oil spill containment and recovery system has been designed which can be built into patrol craft or other vessels. The system comprises two skimmer modules, one built into the hull on each side of the ship. These are used together with inflatable oil booms that project forward and out in a vee configuration. The oil recovery rate, using two 150 m booms, exceeds 1000 tons per hour.

C-1351-76
OIL SKIMMERS NOW IN SERVICE (news brief)

Anon. 1976.
Western Fisheries 91(6):33.

Recovery, Oil spills, Skimmers, Booms

The first five of 24 oil skimmer vessels manufactured for the U.S. Navy by the Marine Construction and Design Co. of Seattle (Marco), are ready for transport to naval bases around the world. The 11-meter vessels can be towed at high speeds to spill sites and rapidly deployed with oil containment booms to maneuver through a spill area, recovering oil and debris.

C-1352-76
OIL SPILL RECOVERY SYSTEM

Anon. 1975.
Marine Equipment News 6(2):18-19.

Oil spills, Recovery, Design and engineering

Summary not available.

[from Underwater Information Bulletin 7(5):#7510-1327. 1976.]

C-1353-76
OIL SPILL SWEEPER (product information)

Anon. 1976.
Pollution Engineering 8(4):46.

Oil spills, Recovery, Design and Engineering

National Marine Service has developed an oil spill sweeper vessel capable of oil recovery rates of up to about 180 metric tons/hour (200 tons/hour). The "Hydrovac" picks up oil without forming emulsions. FFI contact National Marine Service.

C-1354-76
PETROTECH DRAWS BIG EUROPEAN CROWD

Anon. 1976.
Offshore 36(5):282.

Skimmers, Cleanup, Recovery, Oil spills

Among the highlights in the fourth biennial international exhibition and congress, Petrotech '76, was the display of the Komara Mini-skimmer. The skimmer weighs only 50 kilograms and is designed for clearing oil in water as shallow as 20 cm. The skimmer will recover up to 16 tons of oil per hour and can handle oils of all viscosities.

C-1355-76
PROVING OUT POLLUTION CLEANUP

Anon. 1975.
Surveyor 9(1):16-19.

Cleanup, Containment, Oil slicks, Design and engineering

The EPA has constructed a large oil and hazardous materials simulated environmental test tank (OHMSETT). The tank (203 x 20 x 3.3 m) tests and compares oil cleanup equipment under controlled condition without polluting the environment. OHMSETT is equipped to spread and contain oil slicks, simulate waves up to 3/4 m high, wavelengths to 30 m, water currents to 11 km/hr. It recycles virtually all test materials.

[from Pollution Abstracts 7(1):#76-00194. 1976.]

C-1356-76
QUALIFICATIONS FOR TESTING OF OIL SPILL REMOVAL/RECOVERY EQUIPMENT AND SYSTEMS

Anon. (date unknown)
Battelle-Northwest, Engineering Technology Department Richland, Washington 99352.

Oil spills, Recovery, Skimmers, *Testing

Battelle-Northwest has been active in technical areas concerning the testing of oil spill removal/recovery equipment. The test site consists of a large concrete water basin, wave generator, wind generator, towing trolleys, etc. Several evaluations have been done on full-size prototype and production model skimmers.

C-1357-76
SEATTLE BASED 'CLEAN SOUND' GROUP ORDERS 58-FOOT OIL SKIMMER

Anon. 1976.
Western Fisheries 92(2):14,16.

Recovery, Oil spills, Skimmers, Design and engineering, Puget Sound

An 18 m oil spill recovery vessel, developed by Marine Construction and Design Co., Seattle, has been ordered for use in the Puget Sound by Clear Sound, the Seattle-based cooperative of oil and oil transport companies concerned with spill prevention and cleanup. The operating capabilities of the recovery vessel are described.

C-1358-76
SKIMMER WORKS LOW VOLUMES (product information)

Anon. 1976.
The Oil and Gas Journal 74(22):74.

Recovery, Oil slicks, Skimmers

The Floating Saucer Skimmer, Model FS50SK-17E, requires a minimum water depth of 23.5 cm and weighs 11.3 kg. Completely self-contained, it floats on the surface and skims thick or thin slicks as needed. The entire unit is sealed and never needs external lubrication. FFI contact Acme Products Co., Box 51388, Tulsa, Oklahoma 74151.

C-1359-76
SORBENT SCIENCES (product information)

Anon.
Spill Control Company, 828 N. Grand Ave., Covina, Ca. 91724.

Cleanup, Oil spills, Absorption, *Oleophilic polyurethane foams

Several brochures describe the company's comprehensive line of oil spill cleanup products which are based on specially treated, oleophilic polyurethane foams. The products include absorbent booms, pillows, mats, filters, sheets, sweeps and modular cleanup kits for use on land and in water.

C-1360-76
SYSTEM RECOVERS OIL FROM WATER (product information)

Anon. 1976.
Chemical Engineering 83(9):68.

Recovery, Oil spills, Design and engineering

The "Scavenger" recovers light crude and No. 2 fuel oils, diesel and jet fuels, and gasoline from the water surface. The unit is designed for permanent installation in ponds, wells, and for portable use in spill recovery. FFI contact Oil Recovery Systems, Inc., Mason, New Hampshire.

C-1361-76
TURN ANY VESSEL INTO AN OIL RECOVERY UNIT (product information)

Anon. 1976.
Ocean Industry 11(4):245.

Containment, Recovery, Oil slicks, Design and engineering

Bennett Pollution Controls, Ltd., features a modular oil containment and recovery system that can be installed in many types of offshore vessels. Ships can be provided with rapid and effective oil pollution control with this device, which has recovery rates in excess of 1000 tons of oil per hour.

C-1362-76
TWO MINI-SKIMMERS AGAINST POLLUTION

Anon. 1975.
Industrie du Petrole en Monde, Gaz-chimie 43(10):36-37.

Skimmers, Design and engineering, Cleanup, Oil spills

In response to the Torrey Canyon incident, British Petroleum has deployed the "Seapack", an antipollution system based on mobile barriers, and the "Seaskimmer", a mobile skimmer unit. Four separate centers in Lavera, Durban, Kent and Cowes are equipped with these systems.

[from Petroleum Abstracts 16(13):#217,922. 1976.]

C-1363-76
UNEP MEETS BIG BUSINESS

Anon. 1976.
Marine Pollution Bulletin 7(2):17-19.

Cleanup, Pollution prevention, Industries, International agreements

The article discusses the activities of the UN Environment Programme dealing with industry, both at the multinational level and at the regional level, in areas of pollution prevention and cleanup. The Symposium on Petroleum and Environmental Conservation, Teheran, 1975, sponsored jointly by UNEP and the International Petroleum Industry Environmental Conservation Association, is presented as an example of the agency's effort in this field.

C-1364-76
URETHANE FOAM-CHIEF ACTOR IN NAVY'S EFFICIENT NEW OIL SPILL RECOVERY SYSTEM

Anon. 1976.
Western Plastics 2(4):6.

Oil spills, Recovery, Absorption, *Urethane foam

The Navy's Civil Engineering Laboratory has successfully tested a prototype sorbent oil spill recovery system which is capable of recovering about 190,000 liters of oil per hour. The system is portable by aircraft, can be attached to many types of ships and can be readied for use within twelve hours. It consists of a broadcaster, which continually spreads up to 3.6 million small urethane chips per hour over a 6 meter wide swath; a boom-like herding barrier which confines the oil and the chips; a harvester which picks up the saturated chips; and a regenerator which squeezes out the oil and recycles the chips to the broadcaster. The method works effectively in rough weather conditions.

C-1365-76
A METHOD FOR DETERMINING THE DISPERSIVE CAPACITY OF PREPARATIONS USED FOR REMOVING OILS FROM WATER SURFACE (English summary)

Antonova, N.M., O.S. Mochalova, I.A. Nemirovskaya and M.P. Nesterova. 1975.
Okeanologiya 15(2):333-337.

Dispersants, Cleanup, Oil spills

A simple, rapid and effective method which uses a centrifugal field is proposed for the evaluation of dispersants which remove pollutant oil from water.

[from Biological Abstracts 61(5):#28466. 1976.]

C-1366-76
BELT DEVICE FOR COLLECTING FLOATING MATTER FROM WATER SURFACE

Aramaki, K., H. Kawakami, and M. Suzuki. 1975.
U.S. Patent 3,907,685

Recovery, Oil spills, Oil slicks, Design and engineering

The invention relates to an apparatus consisting of an endless belt and pulley system, which is partially submerged in a body of water and positioned at an acute angle to the direction of water flow. This design and arrangement permits the accurate collection of floating oil or other pollutants.

[from Selected Water Resources Abstracts 9(4):#W76-01772. 1976.]

C-1367-76
COAST GUARD'S RESPONSE TO SPILLED OIL

Ard, R.W., Jr. 1976.
Environmental Science and Technology 10(3):239-242.

Oil spills, Remote sensing, Recovery, Source identification, Design and engineering, *U.S. Coast Guard

The responsibilities of the U.S. Coast Guard in oil spill prevention and control are delineated. The technology used by the Coast Guard to detect, recover and identify spills is reviewed.

C-1368-76
SYSTEM MODEL DEVELOPMENT OF TWO FAST CURRENT OIL REMOVAL SYSTEMS

Ard, R.W., Jr., R. Ayers, and R. Beach. 1976.
Offshore Technology Conference, 8th, Houston, 1976. Paper no. OTC-2691. Abstract.

Recovery, Oil spills, Skimmers, Design and engineering

The U.S. Coast Guard has undertaken a program to develop oil recovery systems which will recover oil at relative velocities exceeding 2 km/hr. Two recovery systems have been chosen for further development: the Shell Development Company's ZRV (Zero Relative Velocity) Belt Skimmer, and the Seaward, Inc. Streaming Fiber Device.

C-1369-76
OIL RECOVERY FROM OIL CONTAMINATED WATER

Author unknown. 1974.
Netherlands Patent 7,313,109

Recovery, Oil spills, Design and engineering

Separation of oil from water is effected by a floating device with inlet openings and a collecting chamber for contaminated water. The collecting chamber has an arched cover which comes in contact with the contaminated water surface and is equipped with an oil uptake device to bring the oil into the collecting chamber.

[from Selected Water Resources Abstracts 9(6):#02830. 1976.]

C-1370-76
OIL RECOVERY FROM SPILLS ON WATER

Author unknown. 1974.
Netherlands Patent 7,212,980

Recovery, Oil spills, Skimmers, Design and engineering

The patent relates to a box-like floating oil skimmer supported laterally by flotation pontoons. The open front inlet of the skimmer brings the skimmed oil and water mixture down a slope into an oil-water separation zone. The oil then flows over an adjustable weir into a collection sump; the water is discharged. The whole apparatus is easily dismantled and transported.

[from Selected Water Resources Abstracts 9(6):#02831. 1976.]

C-1371-76
A STUDY OF THE EFFECTS OF DETERGENTS ON TYPICAL BILGE WATERS AND CORRELATION OF OIL PARTICLE SIZES

Batutis, E., H. Hogue, and J. McGinn. 1975.
Final report, USCG-D-117-75, Contact DOT-CG-43287. 222p.

Detergents, Bilges, Emulsification

The study determined the extent of emulsification caused by synthetic detergents on eight oils as a function of detergent type (cationic, anionic, or non-ionic), concentration, temperature, pH, and salinity of the continuous (external) phase. The results and conclusions are documented.

[from Government Reports Announcements 76(7):#AD-A020172/36A. 1976.]

C-1372-76
CLEANUP OF OIL POLLUTION AT SEA AND ON COASTS

Beynon, L.R. 1975.
World Petroleum Congress, 9th, Tokyo, 1975. Vol. 6. p.315-323.

Oil spills, Cleanup, Recovery, Contingency planning

The article summarizes recent efforts to make oil spill retrieval possible under a wide variety of conditions and circumstances. Recent emphasis has also been on proper contingency planning and on methods and materials which do not in themselves have considerable ecological side effects.

[from Petroleum Abstracts 16(20):#219,583. 1976.]

C-1373-76
DETERGENT COMPOSITION

Blanchard, P.M., and D.G. Meeks. 1975.
British Patent 1,419,803

Cleanup, Dispersants, Oil spills, Oil slicks, *Detergents

The patent applies to three compositions for detergents that will disperse oil spills. The formulations can be directly disseminated in sea water for oil slicks or dissolved in kerosene for work on polluted beaches.

[from Chemical Abstracts 84(18):123801d. 1976.]

C-1374-76
USE OF POLYMERIC QUATERNARY AMMONIUM BETAINES AS WATER CLARIFIERS

Buriks, R.S., and A.R. Fauke. 1975.
U.S. Patent 3,929,635

Wastewater treatment, Oil-water separation, Emulsions, Coagulation

Treatment of maleic anhydride-vinyl monomer copolymers with tertiary amines and alkylene oxides results in the formation of the title chemicals, which are useful in coagulating oils in wastewater and for demulsifying oil emulsions from crude petroleum storage tanks.

[from Chemical Abstracts 84(17):122813x. 1976.]

C-1375-76
APPARATUS FOR COLLECTING CONTAMINATED WATER

Chastan-Bagnis, L. 1975.
British Patent 1,408,451

Recovery, Skimmers, Design and engineering

Surface oil contaminants can be collected by an apparatus consisting of a shallow, scoop-like receptacle which is designed to bring the contaminated surface layer of water toward the rear end of the scoop; the contaminated water is then pumped into a storage container.

[from Petroleum Abstracts 16(19):219,373. 1976.]

C-1376-76
OIL SKIMMER WITH LEAD FLOAT AND HINGED WEIR

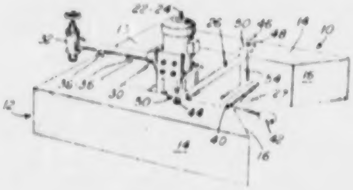
Crisafulli, A.J. 1975.
U.S. Patent 3,923,661

Skimmers, Recovery, Oil slicks, Design and engineering

This collecting and skimming device for removing oil or other floating pollutants consists of two main parts: a U-shpaed flotation or pontoon unit; and a combined collection and pumping unit, with a hinge-mounted weir plate and a lead float to keep the weir plate at the proper position in water. The weir plate can respond to variations in wave heights.

[from Petroleum Abstracts 16(12):#217,699. 1976.]

3,923,661
OIL SKIMMER WITH LEAD FLOAT AND HINGED WEIR
Angelo J. Crisafulli, Box 1051, Glendive, Mont. 59330
Filed June 28, 1974, Ser. No. 485,147
Int. Cl.^{2} E02B *15/04*
U.S. Cl. 210—242 6 Claims



C-1377-76
DEVICE FOR RECOVERING POLLUTING PRODUCTS SPREAD OVER THE WATER SURFACE, IN PARTICULAR OIL PRODUCTS

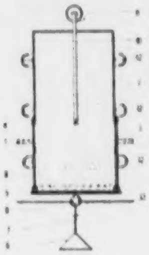
Degobert, P., F. Kermarrec, and Y. Nadand. 1975.
U.S. Patent 3,912,635

Recovery, Oil slicks, Skimmers, Design and engineering

The patent relates to a passive skimming and collecting device which selectively recovers floating liquids that are immiscible with water. The device is a floating container, constructed in part of a porous hydrophobic and oleophilic material, which is readily penetrated by the pollutant but effectively excludes water. The ballasted container absorbs and stores the pollutant for removal.

[from Selected Water Resources Abstracts 9(5):64. 1976.]

3,912,635
DEVICE FOR RECOVERING POLLUTING PRODUCTS SPREAD OVER THE WATER SURFACE, IN PARTICULAR OIL PRODUCTS
Paul Degobert; Francois Kermarrec, both of Rueil-Malmaison, and Yvon Nadaud, Saint-Ouen, all of France, assignors to Institut Francais du Petrole, des Carburants et Lubrifiants, France
Filed Aug. 24, 1973, Ser. No. 391,520
Claims priority, application France, Sept. 18, 1972, 72.33068
Int. Cl.^{2} E02B *15/04*
U.S. Cl. 210—242 14 Claims



C-1378-76
IMPROVED DYNAMIC INCLINE PLANE ENDLESS BELT LAMINAR OIL COLLECTION

Der, J.J. 1975.
U.S. Patent Application AD-D001 932/3

Recovery, Oil slicks, Design and engineering, *Oil collector

In this oil recovering device, a double incline-plane endless belt guides water into a collection chamber in its laminar state. An adjustable slot at the intake of the collection chamber minimizes the water content of the recovered mixture, allowing the oil collector to operate more efficiently and at high speeds.

[from Government Reports Announcements 76(7):#PAT-APPL-625 336/GA. 1976.]

C-1379-76
EFFICIENCY AND RETENTIVITY TESTING AND PERFORMANCE OF SINKING AGENTS IN THE REMOVAL OF OIL SPILLS

Dick, J.G., and A. Feldman. 1975.
Environmental Conservation Directorate Economic and Technical Review, Report EPS-3-EC-75-1. 64p.

Sinking agents, Oil spills, Recovery

This special report identifies techniques for the testing of sinking agents to measure their efficiency in removing oil and retaining oil after the sinking action. The effects of oil layer thickness, free removal and retentivity efficiency are also examined.

[from Environment Abstracts 6(2):#76-01264. 1976.]

C-1380-76
OIL POLLUTION CONTROL TECHNIQUES OFFSHORE

Engdahl, R. 1975.
The Copenhagen Offshore Craft Conference. K.D. Troup (ed.). London, Thomas Reed Industrial Press Ltd., 1975. p.111-116.

Oil spills, Cleanup, Booms, Skimmers, Dispersants

This paper describes five basic systems used by the Swedish Coast Guard to fight offshore oil spills. The largest system uses a 225 metric ton ship equipped with an inflatable oil boom and floating skimmer connected to a tanker or inflatable containers. Other systems include a conveyor belt and a drum formed floating skimmer; a landing-craft-type work boat equipped with various types of oil booms, pickup devices, and storage containers; and a system with portable suction pumps. The last system, used especially for lumpy or viscous oils, employs a specially designed surface operating trawl and derrick-handled gripper apparatus. Widely spread oils are absorbed with peatmoss or synthetics, burned, dispersed with surfactants, or submerged to facilitate biological and chemical degradation.

[from Oceanic Abstracts 13(1):#712. 1976.]

C-1381-76
OIL ABSORBENT MADE OF POLYPROPYLENE FIBERS

Fujimura, T., M. Taniguchi, and S. Hane. 1975.
Japanese Patent 75 05,154

Recovery, Oil spills, Waste oil, Ships, Absorption, *Lipophilic fibers

Porous sheets, mats, tows and ropes processed from lipophilic polyproylene fibers, have excellent oil absorbing capacity, speed, and retention characteristics. The material removes waste oil leaking from ships, waste oil from factories, and oil from sunken tankers.

[from Chemical Abstracts 84(18):#126451a. 1976.]

C-1382-76
OIL ABSORBENT MATERIAL

Fischer Holding Ltd. 1975.
British Patent 1,407,485

Absorption, Oil spills, Cleanup, Recovery, *Peat fibers

When the moisture content of peat is reduced to below 10%, it loses its hydrophilic qualities and becomes hydrophobic and can then be used as a hydrophobic oil absorbent material for spill cleanup and recovery. A method for separating and drying the peat fibers for optimum absorbency is described.

[from Petroleum Abstracts16(19):219,360. 1976.]

C-1383-76
TESTS OF OIL RECOVERY DEVICES IN A BROKEN ICE FIELD

Getman, J.H., L.A. Schulz, and P.C. Deslauriers. 1976.
Offshore Technology Conference, 8th, Houston, 1976. Paper no. OTC-2695. Abstract.

Recovery, Oil spills, Design and engineering, *Equipment testing

The U.S. Coast Guard is conducting tests on several oil spill recovery devices which may be effective for recovery in ice-infested waters. The paper describes the test program and results. Both Lockheed and Marco spill recovery units successfully recovered oil under simulated conditions but proved unreliable in cold environment field tests. Necessary modifications for improved performance have been identified and have been implemented for further tests.

C-1384-76
PERFORMANCE TESTS OF OFF-THE-SHELF OIL SKIMMERS

Griffiths, R. 1976.
Offshore Technology Conference, 8th, Houston, 1976. Paper no. OTC-2696. Abstract.

Recovery, Oil spills, Skimmers, Design and engineering, *Equipment testing

Five commercially available protected-water oil recovery devices were tested for their performance characteristics by the U.S. Coast Guard at the Environmental Protection Agency's test tank facility (OHMSETT). The results of these tests are useful for comparing these five systems for possible inclusion in an oil spill response system.

C-1385-76
TERRESTIAL [sic] SPILLAGE OF OIL IN THE ARCTIC

Herschmiller D.W., and R.D. Revel. 1974.
Water - 1974. I. Industrial Wastewater Treatment. G.F. Bennett (ed.). New York, American Institute of Chemical Engineers, 1974. p.254-260. (AICHE Symposium Series, Vol. 70, no. 144.)

Oil spills, Inland, Arctic, Contingency planning, Cleanup, Disposal

"Based on selected ecological considerations and environmental parameters, a generalized coverage of the applicability of present day oil spill technology to the Arctic is presented. The present mode of approach for combating oil spills is highlighted, and the challenge of the many problems awaiting solution is elucidated."

C-1386-76
RECOVERY OF OIL AND OIL-SOLUBLE CONTAMINANTS FROM THE SURFACE OF WATER

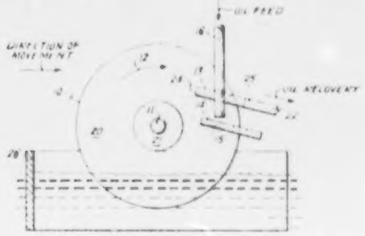
Hoegberg, R.G., and W.S. Tyler. 1975.
U.S. Patent 3,905,902

Recovery, Oil slicks, Design and engineering, *Oleophilic discs

A device and method are described which permit the recovery of oil or oil soluble contaminants from the water surface while minimizing the simultaneous pickup of water. The device consists basically of partially submerged oleophilic polymer discs which are rotated through the water and pick up contaminants at their rims. The contaminants are mechanically removed from the discs.

[from Selected Water Resources Abstracts 9(4):#W76-01714. 1976.]

3,905,902
RECOVERY OF OIL AND OIL-SOLUBLE CONTAMINANTS FROM THE SURFACE OF WATER
Ruth G. Hoegberg, 209 Matroy Ln., Wallingford, Pa. 19086, and Walter S. Tyler, Valley View, R.D. No. 1, Landisburg, Pa. 17040
Continuation-in-part of Ser. No. 180,729, Sept. 15, 1971, abandoned. This application Sept. 10, 1973, Ser. No. 395,683
Int. Cl.² B01D *15/00*
U.S. Cl. 210—30 **10 Claims**



C-1387-76
PREVENTION-THE SOLUTION TO OIL SPILLS

Jones, D.R. 1974.
Water-1974: I. Industrial Wastewater Treatment. G.F. Bennett (ed.). New York, American Institute of Chemical Engineers, 1974. p.247-253. (AICHE Symposium Series, Vol 70, no.144.)

Pollution prevention, Government agencies, Oil spills, Recovery, Cleanup, Oil discharges

In spite of increasingly effective contingency planning and technology available for cleanup and control of oil spills, only about 20 percent of oil spilled in U.S. waters in 1972 was recovered. It is now recognized that a vigorous offense in the form of spill prevention is the only really effective solution. Current spill prevention programs of the U.S. Coast Guard and the Environmental Protection Agency are outlined and reviewed. These programs are designed to prevent discharges of oil from onshore and offshore facilities during production, transfer, and storage of oil.

C-1388-76
BAGASSE OIL CATCHES

Kinorshita, H. 1976.
Japanese Kokai (unexamined patent application) 76 05,289

Adsorption, Cleanup, Recovery, *Bagasse

"Bagasse activated at 80-100° was sprayed with 2% molten stearic acid and formed using 20% aqueous CM-cellulose as binder to give adsorbent useful as oil catch."

[from Chemical Abstracts 84(22):#155381h. 1976.]

C-1389-76
EFFECTS OF THREE EMULSIFYING AGENTS AGAINST CRUDE OIL ON THE PRIMARY PRODUCTION OF AN EXPERIMENTAL COMMUNITY OF BENTHIC DIATOMS

Lacaze, J.C. 1974.
Environmental Protection Agency, EPA-TR-56-75, PB-237-812-T/BE. 19p.
[Translation of Vie Milieu (France) 28(1), series B. p.51-57. 1972-1973.]

Emulsifiers, Biological effects, Microorganisms, *Benthic diatoms

The effects of three oil emulsifying agents on the primary productivity of benthic diatoms were studied. Two substances, Sefoil and Corexit, do not change primary production; while the third, Gamosol, is toxic.

[from EPA Reports Bibliography Quarterly. Jan.-March, 1975. PB-242-075-01.]

C-1390-76
INFLUENCE OF THE ILLUMINATION OF A NON-IONIC SURFACTANT USED FOR THE DISPERSION OF OIL SPILLS AT SEA

Lacaze, J.C. 1974.
Environmental Protection Agency, EPA-TR-59-75, PB-237-805-T/BE. 10p.
[Translation of Comptes Rendus (France)277:409-412. 1973.]

Oil spills, Dispersions, Biodegradation, Surfactants, *Illumination

Preliminary studies on the influence of illumination indicate that even a weak illumination can slow down the biodegradation process.

[from EPA Reports Bibliography Quarterly. Jan.-March, 1975. PB-242-075-01.]

C-1391-76
LOW TOXICITY OIL EMULSIFIER

Makabe, K., and T. Imamura. 1975.
Japanese Kokai (unexamined patent application) 75 40,483

Cleanup, Emulsification, Oil spills, Toxicity, Marine organisms

Polyglycerol derivatives containing ≥ 1 acyloxy and alkylenedioxy groups are significantly more efficient than conventional oil emulsifiers for oil spills; they have a far lower toxicity to fish and other sea life.

[from Chemical Abstracts 84(12):#79330y. 1976.]

C-1392-76
DETERGENT COMPOSITIONS

Mann, A.H. 1975.
British Amended Patent 1,280,259

Cleanup, Oil spills, Emulsification, *Detergents

"Detergents useful for emulsifying petroleum oils spilled on water or on shores and which have reduced toxicity for aquatic life comprise 15-30% polyoxyethylene glycol monooleate, mol. wt. 480, and odorless kerosine."

[from Chemical Abstracts 84(18):#126524b. 1976.]

C-1393-76
FUEL MADE FROM THERMOPLASTIC FIBERS AND OIL

Martinez, B.P. and M.D. Zeisberg. 1975.
U.S. Patent 3,923,472

Reuse, Waste oil, Absorption

The patent relates to a process and system in which waste oil, such as oil spilled in water, is first collected and absorbed by a filter made of thermoplastic synthetic fibers. When saturated with oil, the fibers are heated until they are liquified. The resulting liquid is then used as fuel.

[from Chemical Abstracts 84(18):#124288d. 1976.]

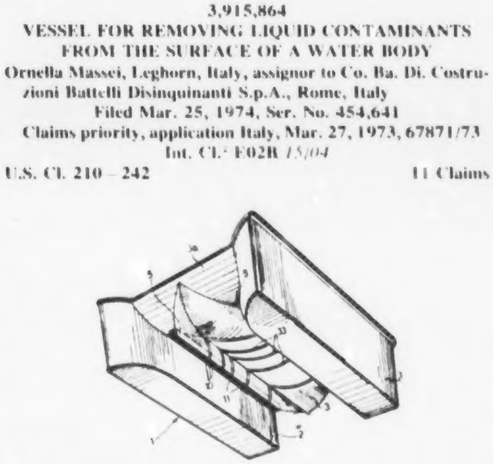
C-1394-76
VESSEL FOR REMOVING LIQUID CONTAMINANTS FROM THE SURFACE OF A WATER BODY

Massei, O. 1975.
U.S. Patent 3,915,864

Recovery, Oil slicks, Skimmers, Design and engineering

A specially designed boat is described which removes floating liquid contaminants, such as oil, from water. The boat has pontoons mounted on both sides for collecting and decanting the contaminant. As the boat moves, its V-shaped hull deflects surface water into channels which are designed to form vortices that concentrate and accumulate the floating contaminant. The accumulated liquid is then pumped into the storage pontoons.

[from Selected Water Resources Abstracts 9(6):#02611. 1976]



3,915,864
VESSEL FOR REMOVING LIQUID CONTAMINANTS
FROM THE SURFACE OF A WATER BODY
Ornella Massei, Leghorn, Italy, assignor to Co. Ba. Di. Costruzioni Battelli Disinquinanti S.p.A., Rome, Italy
Filed Mar. 25, 1974, Ser. No. 454,641
Claims priority, application Italy, Mar. 27, 1973, 67871/73
Int. Cl.^{2} E02B *15/04*
U.S. Cl. 210 – 242 11 Claims

C-1395-76
COTTON-THE NATURAL SORBENT FOR COMBATING OIL POLLUTION

Meenaghan, G.F., J.E. Halligan, A.A. Ball, and J.F. Leary. 1976. Offshore Technology Conference, 8th, Houston, 1976. Paper no. OTC-2698. Abstract.

Cleanup, Recovery, Oil spills, Absorption, *Cotton wastes

The paper discusses the results of a study to develop a sorbent oil recovery, retrieval, and incineration system which uses cotton wastes as the sorbent. The sorbency efficiency of the cotton, its reusability and its physical properties are discussed. It has been found that about 5 to 22 g cotton can absorb nearly 450 g of oil, and this efficiency is relatively independent of crude type, channel velocity and effective sorbent contact time.

C-1396-76
FAST CURRENT OIL RESPONSE SYSTEM

Mueller, F.N. 1975.
Final report, USCG-D-115-75, Contract DOT-CG-40220-A. 86p.

Recovery, Oil slicks, Booms, Design and engineering

An oil pollution recovery system consists of two long booms arranged in a "V" shape and a collector system which uses a flow-through trough and a second air boom to skim off the surface into an oil concentrator. In tests the "Vee" air booms successfully herded the oil with efficiencies ranging from 100% at 0.3 m/sec to 80% at 2 m/sec.

[from Government Reports Announcements 76(7):#AD-A020 171/56A. 1976.]

C-1397-76
DEVELOPMENT AND PRELIMINARY DESIGN OF AN EXPERIMENTAL PROTOTYPE FREE VORTEX OIL SKIMMER

Nebeker, E.B., and S.E. Rodriguez. 1975.
Final Report, USCG-D-152-75, Contract DOT-CG-42732-A. 95p.

Recovery, Oil spills, Skimmers, Design and engineering

The skimmer system, developed by Scientific Associates, Inc., possesses performance characteristics for various operating situations. It is particularly applicable to operating conditions of specific interest to the Coast Guard: oil films 5.1 cm thick and less, operation while stationary and in currents up to 1.4 km/hr, and severe Sea State 4 waves.

[from Government Reports Announcements 76(7):#AD-A020174/9GA. 1976.]

C-1398-76
SAFETY OF OIL SPILL DISPERSANTS AND THE PRESENT CONDITION OF THEIR DEVELOPMENT

Ookubo, K. 1975.
Kogaku Kojo 19(4):21,28-30.

Dispersants, Oil spills, *Safety

The article discusses the safety of various oil dispersants and traces their development.

[from Chemical Abstracts 84(12):#79215q. 1976.]

C-1399-76
FORAMINOUS COMPOSITION FOR REMOVAL OF OLEOPHILIC MATERIAL FROM THE SURFACE OF WATER

Orban, J. and C.E. Case. 1975.
U.S. Patent 3,917,528

Cleanup, Oil spills, Crude oil, Absorption

A porous substrate which is impregnated with a drying oil (castor oil, safflower oil, etc.) is more effective in rapidly absorbing crude oil from water than an untreated substrate.

[from Selected Water Resources Abstracts 9(7):#W76-03012. 1976.]

C-1400-76
COMPOSITION FOR THE REMOVAL OF OILY SUBSTANCES

Orii, T., and M. Watanabe. 1975.
British Patent 1,395,095

Cleanup, Crude oil, Dispersions, Emulsions

A composition which disperses crude petroleum and petroleum oils and forms stable emulsions is made from a mixture of at least two chlorinated hydrocarbons plus a polyoxyethylene type, nonionic surface-active agent.

[from Petroleum Abstracts 16(19):219,372. 1976.]

C-1401-76
TREATMENT OF FLOATING POLLUTANTS

O'Sullivan, D.J., and B.J. Bolger. 1975.
U.S. Patent 3,919,083

Cleanup, Oil spills, Containment, *Polymerization

Oily waterborne pollutants can be treated with monomers which polymerize in the presence of moisture, such as monomeric esters of 2-cyanoacrylic acid. Polymerization incorporates the pollutants in a matrix, thus preventing further spreading.

[from Petroleum Abstracts 16(11):#217,423. 1976.]

C-1402-76
REMOVAL OF IMMISCIBLE FLUIDS FROM WATER SURFACE AND LAKE BEDS

Peterson, E.C. 1976.
U.S. Patent 3,933,632

Cleanup, Oil slicks, Oil spills, Adsorption

An effective oil adsorbent material is made from a mixture of lead slag mineral wool and treated with a hydrophobic substance such as oleic acid, finely divided natural stone, and iron, aluminum and magnesium oxides. This compound is placed on the water surface until the oil or other immiscible fluid is adsorbed.

[from Petroleum Abstracts 16(16):#218,668. 1976.]

C-1403-76
DEVICE FOR DAMPING THE SURGE OF WATER WAVES PARTICULARLY FOR A FLOATING BODY DESIGNED TO CLEAN POLLUTED WATER

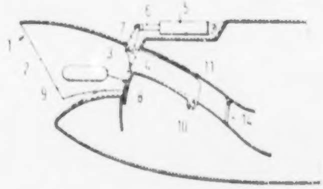
Rafael, J. 1975.
U.S. Patent 3,909,417

Design and engineering, Cleanup, Recovery, Oil spills, *Wave damping

The invention relates to a device which can be attached to a vessel and which damps the oncoming surge of waves to make cleanup and recovery of oil spills easier.

[from Selected Water Resources Abstracts 9(4):#W76-01731. 1976.]

3,909,417
DEVICE FOR DAMPING THE SURGE OF WATER WAVES PARTICULARLY FOR A FLOATING BODY DESIGNED TO CLEAN POLLUTED WATER
Johann Rafael, Maxstrasse 36, Salzburg, Austria
Filed Sept. 25, 1973, Ser. No. 400,632
Claims priority, application Germany, Sept. 25, 1972, 2246957
Int. Cl.^{2} E02B *15/04*
U.S. Cl. 210—242 **8 Claims**



C-1404-76
FLOATABLE VESSEL

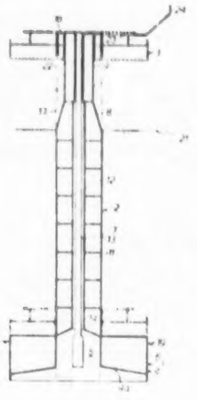
Redshaw, L. 1975.
U.S. Patent 3,921,558

Recovery, Natural seepage, Design and engineering

A floatable vessel for the recovery of oil escaping from the sea bed is described. The unit consists basically of a lower ballasted chamber connected by an upright columnar conduit to a floating collection chamber. At the base of the ballast chamber is a conical, inverted, funnel-shaped opening for collecting the rising oil.

[from Petroleum Abstracts 16(16):#218,659. 1976.]

3,921,558
FLOATABLE VESSEL
Leonard Redshaw, Lancashire, England, assignor to Vickers Limited, London, England
Filed Sept. 16, 1974, Ser. No. 506,407
Int. Cl.^{2} B63B *35/44*
U.S. Cl. 114—.5 T **10 Claims**



C-1405-76
OIL SPILL CONTROL-THE STATE OF THE ART

Roberts. October, 1974.
Society of Naval Architects and Marine Engineers, Pacific Northwest, local section paper.

Oil spills, Cleanup, Recovery, Design and engineering

Summary not available. (May be purchased from SNAME, 74 Trinity Place, New York, N.Y. 10006.)

[from Marine Technology 12(4):471. 1976.]

C-1406-76
ENVIRONMENTAL EMERGENCY TECHNOLOGY: A KEY ELEMENT OF PREPAREDNESS

Ruel, M., and S. Ross. 1974.
Water-1974: I. Industrial Wastewater Treatment. G.F. Bennett (ed.). New York, American Institute of Chemical Engineers, 1974. p.270-276.

Oil spills, Pollution prevention, Cleanup, Recovery, Canada

The major kinds of equipment, materials and techniques which are currently used in the prevention, containment and cleanup of oil spills are discussed. Emphasis is placed on identifying the many climatic and environmental conditions in offshore and onshore Canada for which cleanup technology development is urgently needed.

C-1407-76
GUIDE TO WATER CLEANUP MATERIALS AND METHODS

Samsel, A. (ed.). 1974.
Massachusetts, Arthur D. Little Inc., 1974. 335p.

Cleanup, Recovery, Manuals, Design and engineering

Current data on operating specifications, compatibility, performance, and applications of various types of equipment are reviewed. Information regarding laws and regulations, government agencies, and contingency planning for water cleanup is included. Oil recovery equipment, such as booms, skimmers and separators, are covered in detail.

[from Water and Sewage Works, Reference Numer 1976: R-224.]

C-1408-76
THE DESIGN, CONSTRUCTION AND TESTING OF A ROUGH WATER DISC-DRUM OIL RECOVERY SYSTEM

Scharfenstein, C.F. 1975.
Society of Naval Architects and Marine Engineers, San Diego section, April 12, 1975.

Design and engineering, Recovery, Oil spills, *U.S. Coast Guard

The Lockheed rough water disc-drum oil recovery system developed for the Coast Guard was designed primarily to provide the hardware and plans for the full-scale open-sea evaluation of the technology and procedures to conduct oil-spill control and recovery operations. The phases of development of the unit are described.

[from MRIS Abstracts 12:#126952. 1976.]

C-1409-76
THE LOCKHEED OFFSHORE OIL RECOVERY SYSTEM

Scharfenstein, C.F. 1975.
Annual Institute of Environmental Sciences Technical Meeting, 21st, Mt. Prospect, Illinois, 1975. Vol 1. p.73-80.

Recovery, Oil spills, Design and engineering

The design, construction, and testing of the Lockheed rough water disk-drum oil recovery system are described. This apparatus can operate at up to sea state 4 with ≤ 40 km/hr. winds and currents ≤ 4 km/hr; it is most effective with crude oils or their emulsified equivalents.

[from Petroleum Abstracts 16(11):#217,424. 1976.]

C-1410-76
HIGH SEAS OIL SPILL CONTROL PROGRAM OF THE SUPERVISOR OF SALVAGE

Sea, R. 1976.
Offshore Technology Conference, 8th, Houston, 1976. Paper no. OTC-2697. Abstract.

Oil spills, Recovery, Skimmers, Booms, Design and engineering, *Equipment testing

Since 1973, the Supervisor of Salvage USN has undertaken a program of developing an oil spill recovery system that is effective, reliable, and will perform in a wide range of operational conditions. A thoroughly tested system resulting from this program consists of a vessel type skimmer, containment boom, buffer system and POL offloading system. Lessons learned in the development of this apparatus are discussed.

C-1411-76
THE SEPARATION FROM A BODY OF LIQUID OF A CONTAMINATED LAYER SPREAD OVER THE LIQUID

Seaclean, S A. 1975.
British Patent 1,396,155

Cleanup, Recovery, Oil slicks

Floating oil can be skimmed off the water surface by first encircling a part of the oil layer, then decreasing the circumference of the enclosed area, thereby thickening the oil layer and facilitating its removal.

[from Petroleum Abstracts 16(18):#219,209. 1976.]

C-1412-76
REMOVAL OF FLOATING POLLUTANTS

Seymour, E.V., and R.R. Ayers. 1975.
U.S. Patent 3,928,205

Oil spills, Cleanup, Recovery, Absorption

The patent relates to an apparatus and method for removing floating oil or other pollutant liquids by absorption with a series of connected sorbent pads. When saturated, the pads are retrieved, the pollutant is removed, and the sorbent bodies are returned to the water surface.

[from Petroleum Abstracts 16(15):#218,375. 1976.]

C-1413-76
SLICKBAR OIL BOOMS AND SLICKSKIM SKIMMER HEADS (product information)

Slickbar Inc. 1976.
Industrial Wastes Information Bulletin 6(4):HMS 5980.

Containment, Recovery, Oil spills, Streams, Harbors

The brochure describes an apparatus and system for the containment and recovery of oil spills in streams, rivers, harbors and open sea. The skimmer consists of a flat oil collecting disk with an attached pump and is effective in less than 10 cm of water.

C-1414-76
SEA-WATER OIL SPILL CLEANING SYSTEM

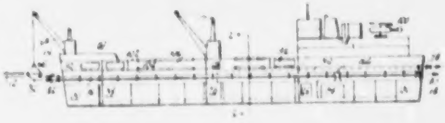
Strain, P.J. 1975.
U.S. Patent 3,922,225

Cleanup, Oil spills, Design and engineering, Oil-water separation

This system for cleaning up oil spills involves a two-step oil-water separation process. The first separation is effected at the bow of a ship; a second separation occurs as the oil is taken into the ship and passed through a baffled conduit. The separated oil is then stored or passed to waiting tanker ships. Modifications of this basic apparatus, which accomodates high waves or shallow coastal water conditions, are described.

[from Petroleum Abstracts 16(11):#217,419. 1976.]

3,922,225
SEA-WATER OIL SPILL CLEANING SYSTEM
Patrick J. Strain, 27 Tanglewood Drive, Lynwood, Ottawa, Ontario, Canada
Filed Feb. 19, 1974, Ser. No. 443,742
Int. Cl.^{2} E02B *15/04*
U.S. Cl. 210—242 **1 Claim**



C-1415-76
A FERROMAGNETIC SORBENT SYSTEM FOR OIL SPILL RECOVERY

Turbeville, J.E. 1976.
Offshore Technology Conference, 8th, Houston, 1976. Paper no. OTC-2693. Abstract.

Oil spills, Recovery, Absorption, *Ferromagnetic sorbents

A totally new technique for oil spill recovery is described. The technique is based on the use of ferromagnetic sorbents made either from small polystyrene spheres or sponge-like, reusable polyurethane foam. The ferromagnetic sorbents, once saturated with oil, are easily recovered and collected by magnetic means.

C-1416-76
COMMERCIAL RESOURCES FOR OIL SPILL REMOVAL

Usher, D. 1976.
Industrial Pollution Conference, 4th, Houston, Texas, 1976. McLean, Virginia, Water and Wastewater Equipment Manufacturers Association, 1976. p.LIX 1-LIX 2.

Oil spills, Cleanup, Pollution prevention, Industry, Government agencies

The objectives and activities of the Oil Spill Control Association of America, which includes state and federal government agencies, major oil spill contractors and major suppliers of oil pollution prevention materials and equipment, are outlined. The group promotes cooperation and coordination between government and the private sector in oil spill cleanup.

C-1417-76
EXEMPLE D'INTEGRATION INDUSTRIELLE D'UNE TECHNIQUE DE LUTTE CONTRE LA POLLUTION ACCIDENTELLE DES MERS PAR LES HYDROCARBURES (EXAMPLE OF INDUSTRIAL INTEGRATION IN AN ACCIDENTAL MARINE HYDROCARBON POLLUTION CONTROL TECHNIQUE)

Vandon, B. 1974.
Colloq. Int. Sur l'Exploit. des Oceans, 2nd, Paris, 1974. Paris, Assoc. pourl' Organ. de Colloq. Oceanol. a Bordeaux. 1974. Vol. 5. Pap. Bx. Ca. 309. 18p.

Cleanup, Oil spills, Contingency planning, Industries

A large oil spill and its control by cooperative methods are described. A five-phase plan for production, transportation, storage, sea transport and spreading of the chemicals used is outlined.

[from The Engineering Index Monthly 14(1):#006893. 1976.]

C-1418-76
BOULTON OIL/WATER SEPARATION SYSTEM (product information)

William Boulton, Ltd. 1976.
Industrial Wastes Information Bulletin 6(4):#HMS 5901.

Oil slicks, Skimmers, Oil-water separation, Design and engineering

A new floating skimmer apparatus to remove oil films is claimed to be substantially cheaper than that of competitors, has no moving parts, operates continuously, and is sealed to prevent algal growth. The unit typically reduces oil concentrations from 2000 to under 10 ppm. FFI contact William Boulton Ltd, Providence Engineering Works, Burslem, Stoke-on-Trent ST6-3BQ, England.

C-1419-76

COMPOSITIONS AND SYSTEMS TO RECOVER OILS FROM AQUEOUS AND SOLID SURFACES

Winkler, A. 1975.
U.S. Patent 3,929,631

Recovery, Oil spills, Absorption, Coagulation

Oil floating on water can be absorbed, coagulated, and recovered with expanded polystyrene or polystyrene-butadiene particles coated with paraffin, naphthalene and/or a mixture thereof.

[from Petroleum Abstracts 16(15):#218,376. 1976.]

3. RESTORATION

C-1420-76
CALM AND PRACTICAL RESTORATION SHOWS OIL SPILLS DO NOT IMPAIR SOIL PERMANENTLY

Anon. 1976.
Oilweek 27(1):100-101.

Oil spills, Soil, Cleanup, Biodegradation

A study of past oil spills on land shows that soil is not permanently impaired. Cleanup and restoration programs should maximize the amount of biological activity, nutrients, moisture and aeration in the soil; minimize CO_2 in soil, and adjust the pH conditions of optimal biodegradation.

[from Petroleum Abstracts 16(16):#218,664. 1976.]

C-1421-76
ALL THAT FUSS OVER A FEW BIRDS...

White, J. 1976.
Outdoor California 37(2):8-9.

Birds, *Treatment procedures

Procedures are outlined which are used by the International Bird Rescue Research Center in Berkeley to save oil-soaked birds. The treatment includes repeated cleansing with solvents, injection and forced feeding of antishock medication with water, sugar and salt, followed by a few days of feeding and care. Time required is about 2-3 man hours per bird, the cost is about $20 per bird, and survival rates are nearly 50%.

4. OIL TRANSFER AND TRANSPORT

C-1422-76
BANTRY OILSPILLS CURBS TIGHTENED

Anon. June 28, 1975.
Oilman. p.4.

Oil transfer, Tankers, Oil spills, Bantry Bay, Pollution prevention

Two recent major oil spills at Gulf Oil Corporation's Whiddy Island tanker terminal have resulted in a comprehensive reassessment of the company's oil pollution prevention and control systems. The company is now attempting to introduce failsafe oil pollution control measures at each of its 12 tanker terminals around the world. These measures will include 24 hour patrolling and monitoring, training of fast response teams, cleanup and recovery craft and equipment booms, dispersants, and spraying equipment.

C-1423-76
CONSTRUCTION PICKS UP ON TEESSIDE TERMINAL

Anon. 1976.
Ocean Industry 11(3):41.

Environmental protection, North Sea, Wastewater treatment, Monitoring, *Oil terminal

The Teesside oil terminal, including the enormous Greatham crude oil storage complex, is expected to be completed by early 1977. Measures to protect the environment against pollution include a wastewater and tanker ballast treatment plant, a hydrocarbon monitoring and alarm system, and a launch equipped to handle oil slicks.

C-1424-76
FINAL ENVIRONMENTAL IMPACT STATEMENT: REGULATIONS FOR TANK VESSELS ENGAGED IN THE CARRIAGE OF OIL IN DOMESTIC TRADE

Anon. 1975.
U.S. Coast Guard, Marine Safety Council, G-CMC/82. 315p.

EIS, Regulations, Tankers, Design and engineering, Pollution prevention

Included in these regulations are requirements governing the design, construction, repair, and operation of U.S. tankers to significantly reduce operational pollution and to provide added protection against outflow in the case of accidents to new tank vessels. These regulations are a part of the implementation of Title II of the Ports and Waterways Safety Act of 1972.

[from MRIS Abstracts 12:#126050. 1976.]

C-1425-76
OFFSHORE PETROLEUM TRANSFER SYSTEMS FOR WASHINGTON STATE. A FEASIBILITY STUDY

Anon. 1974.
Final report, OIW/OCW-7401. 534p.

Oil transfer, Offshore development, Washington, Oil spills

The feasibility of offshore petroleum transfer systems in Washington State is examined in terms of engineering, economic, social, environmental and jurisdictional considerations. The report projects petroleum demand and supply for western market areas through the year 2000, conceptualizes 13 alternative port systems with adjacent processing facilities; and forecasts through a risk assessment the incidence of tanker casualty and oil spills resulting from various oil transfer and processing operations.

[from Government Reports Announcements 76(4):#PB-244 945/26A. 1976.]

C-1426-76
SEGREGATED BALLAST REQUIRED ON BIG TANKERS(news brief)

Anon. 1976.
National Petroleum News 68(4):90.

Regulations, Tankers, Segregated ballast, *U.S. Coast Guard

The U.S. Coast Guard has adopted regulations covering construction and distribution of segregated ballast tanks within hulls of seagoing tankers and barges of 70,000 dwt or more. The provisions of the new rules, which were effective January 8, 1976, are briefly discussed.

C-1427-76
A RISK AND COST ANALYSIS OF TRANSPORTING AND STORING GULF OF ALASKA OUTER CONTINENTAL SHELF OIL

Booz-Allen and Hamilton, Inc. 1975.
Contract EPA-68-01-2467. 105p.

Oil transport, Storage, Alaska, Gulf of, OCS, Oil spills

This study evaluates the alternate modes of transporting and storing oils in transit from the Alaskan OCS oil fields to U.S. West Coast terminals and processing facilities, in order to measure the risk of oil spills and estimate costs involved.

[from Government Reports Announcements 76(6):#PB-248 739/5BE. 1976.]

C-1428-76
A RISK AND COST ANALYSIS OF TRANSPORTING SOUTHERN CALIFORNIA OUTER CONTINENTAL SHELF OIL

Booz-Allen and Hamilton, Inc. 1975.
Contract EPA-68-01-2467. 113p.

Oil transport, California, OCS, Oil spills

This report evaluates alternative modes of transporting oil from proposed OCS lease areas to onshore processing facilities in Southern California. The purpose of the study is to give policymakers a clearer picture of development options available in terms of oil spill risk and costs.

[from Government Reports Announcements 76(6):#PB-248 738/7BE. 1976.]

C-1429-76
ANALYSIS OF THE RELATIVE POLLUTION RISK AND ECONOMICS OF SHIPS VERSUS PIPELINES FOR THE TRANSPORT OF OCS OIL TO ONSHORE TERMINALS

Donovan, L.J., J. Mulhern, and S.C. Fischer. 1976.
Offshore Technology Conference, 8th, Houston, 1976. Paper no. OTC-2715. Abstract.

Oil transport, Tankers, Ships, Pipelines, Oil spills, *Risk analysis

Booz-Allen and Hamilton, Inc. has conducted a study for the U.S. Environmental Protection Agency in which the overall environmental risks and associated economics of alternative crude oil transporting systems for offshore California were compared. Their analysis indicates that tankers are five to seven times more risky than submarine pipelines, and that nearly all of the oil spilled will come from a very small number of large spills exceeding 1000 barrels.

C-1430-76
THE U.S. PETROLEUM TRANSPORTATION DILEMMA

Duncan, and Lutkus. September, 1975.
Society of Naval Architects and Marine Engineers, New England, local section paper.

Oil transport, Petroleum industry, Tankers, Pollution prevention

Summary not available. (May be purchased from SNAME, 74 Trinity Place, New York, N.Y. 10006.)

[from Marine Technology 12(4):471. 1976.]

C-1431-76
DESIGN AND CONSTRUCTION OF THE SAN CLEMENTE CLASS TANKER

Evans, and Uberti. 1975.
Society of Naval Architects and Marine Engineers, Spring Meeting, 1975.

Oil transport, Tankers, Design and engineering

Summary not available. (May be purchased from SNAME, 74 Trinity Place, New York, N.Y. 10006.)

[from Marine Technology 12(4):471. 1976.]

C-1432-76
MEANS OF MINIMIZING POLLUTION AT CONVENTIONAL PIER AND SEA ISLAND FACILITIES

Fetter, C.H., Jr. 1976.
Offshore Technology Conference, 8th, Houston, 1976. Paper no. OTC-2692. Abstract.

Oil transfer, Pollution prevention, Oil discharges, Personnel training, Monitoring

This paper describes methods to prevent or minimize accidental discharges of oil and other potentially harmful liquids during berthing, mooring and cargo transfer operations. Operator error is reported to be the single largest cause of pollution incidents at marine terminals; therefore, emphasis is on improved personnel training and performance and instrumentation for detecting and monitoring pollution.

C-1433-76
THE INTERRELATIONSHIP OF SYSTEM PROPERTIES, SPILL QUANTITIES, MATERIAL PROPERTIES, AND TOXICITY IN THE EVOLUTION OF WATER POLLUTION HAZARD OF TRANSPORTED MATERIALS

Hann, R.W., and P.A. Jensen. 1975.
International Symposium on Transport of Hazardous Cargoes by Sea and Inland Waterways, 4th, Jacksonville, 1975. 18p.

Oil transport, Oil spills, *Environmental risks

A project aimed to provide an improved technique for assessing and quantifying the risk to the environment resulting from shipping hazardous materials on U.S. waterways is reported.

[from MRIS Abstracts 12:#127077. 1975.]

C-1434-76
ENVIRONMENTAL ANALYSIS FOR BAHAMAS SUPERTANKER PORT

Harrison, W. 1974.
Coastal Engineering Conference, 14th, Copenhagen, Denmark, 1974. Vol. III. p.2551-2567.

Environmental effects, Tankers, Ports, Bahamas, Oil spills

For oil pollution considerations, the best locations for a supertanker port are along the western margin of the Great Bahama Bank, Little Bahama Bank, and Grand Bahama Island. Large boundary currents would tend to carry large accidental oil spills away from coastal waters and into the North Atlantic. The choice of a site near Freeport, Grand Bahama Island, was tested by releasing six crude oil and two naphtha spills during the windiest month. The environmental suitability of the site was confirmed by the successful capture and cleanup of these small spills.

C-1435-76
OCEAN TANKER POLLUTION PREVENTION EXPERIENCE

Hemminghaus, R.R. and D.E. Cornett. 1974.
Conference on Pollution Control in the Maritime Industries, Washington, D.C., 1974. p.117-121.

Tankers, Pollution prevention. Load-on-top, Oil discharges

Exxon Company, USA's pollution prevention experience on oceangoing vessels is outlined. The Load-on-top (LOT) ballast procedure is being used on tankers carrying persistent and nonpersistent oils to minimize operational discharge. This procedure and Exxon's control of accidental discharges are discussed.

[from MRIS Abstracts 12:#098200. 1976.]

C-1436-76
ALTERNATIVE INLAND TANK BARGE DESIGN FOR POLLUTION AVOIDANCE

Karlson, Lauridsen, Foltis, and Sargent. 1974.
Society of Naval Architects and Marine Engineers, Spring Meeting, 1974.

Oil transport, Tankers, Inland, Pollution prevention, Design and engineering

Summary not available. (May be purchased from SNAME, 74 Trinity Place, New York, N.Y. 10006.)

[from Marine Technology 12(4):471. 1976.]

C-1437-76
DAMAGE STABILITY REQUIREMENTS FOR TANKSHIPS, CHEMICAL SHIPS, AND GAS SHIPS

Kime, J.W., R.E. Johnson, and W.D. Rabe. 1976.
Marine Technology 13(2):121-151.

Tankers, Pollution prevention, Regulations

The early history of oil tanker regulations is reviewed, and requirements for minimizing oil pollution from oil tankers due to side and bottom damages are stated.

C-1438-76
THE PROBLEMS OF OPERATING MAMMOTH TANKERS ON THE CAPE SEA ROUTE

Little, I.C. 1974.
Navigation 22(1):81-85.

Oil transport, Tankers, Oil spills, *Cape Sea route

The article discusses various problems and difficulties encountered by tankers and supertankers forced to use the Cape Sea route for oil transport since the closure of the Suez Canal. The threat of oil spillage and pollution by grounding or collision is described; new antipollution measures are outlined.

[from Oceanic Abstracts 13(1):#888. 1976.]

C-1439-76
SALT OF THE EARTH

Markun, P.M. 1976.
Petroleum Today 17(1):22-25.

Crude oil, Storage, Enviromental protection, *Salt domes

The article points out the advantages of storing crude oil and petroleum products in natural underground salt domes. The method is far more economical than above ground storage in tanks; it takes up little room above ground and has very few adverse environmental effects, such as surface or groudwater pollution. The method is also far safer from fire and sabotage than aboveground storage facilities.

C-1440-76
THE ROLE OF ENGINEERING IN MINIMIZING OFFSHORE IMPACTS

Muga, B.J. 1975.
Report of the Conference on Marine Resources of the Coastal Plains States, Savannah, Georgia, 1975. Wilmington, North Carolina, Coastal Plains Center for Marine Development Services, 1975. p.77-79.

Oil transfer, Design and engineering, Tankers, Ports, Pollution prevention

This paper discusses recent technological developments in the areas of tanker and VLCC mooring, offloading systems, and ship construction and operation that will minimize the danger of ship collision, oil spills, and oil pollution from dirty tanker ballast waters.

C-1441-76
OIL TRANSPORTATION BY TANKERS: AN ANALYSIS OF MARINE POLLUTION AND SAFETY MEASURES

Office of Technology Assessment, Washington, D.C. 1975.
PB-244457/8. 305p.

Tankers, Oil transport, Oil spills, Design and engineering, Pollution prevention

This report describes and discusses various topics related to the operation of tankers and supertankers, including their potential for causing oil pollution. It also describes alternatives in the design, construction and operation of these ships with respect to oil pollution prevention.

[from Scientific and Technical Aerospace Reports 14(6):#15684. 1976.]

C-1442-76
OF BERGY BITS AND GROWLERS (letter to editor)

Ruffman, A. 1976.
Science 192(4234):7.

Tankers, Oil spills, *Icebergs

Although collisions between ships and icebergs have become rare in recent years, there is still the danger of oil spillage resulting from oil tanker collisions with small, low-lying or concealed bodies of ice called bergy bits and growlers. These bodies of ice are very difficult to detect visually or by radar and are extremely difficult to tow from shipping lanes. The collision of the freighter "Ivory Star" is cited as an example of this problem.

C-1443-76
SUBMARINE PIPELINE LEAK LOCATOR OR THE LIKE

Uhlarik, W.J.
U.S. Patent 3,933,031

Offshore pipelines, Leakage, Design and engineering

An apparatus is described which detects the location of leaks in submarine oil pipelines. The device does not need a vacuum to determine liquid pressure differences and is independent of atmospheric pressure changes and tidal level fluctuations.

[from Petroleum Abstracts 16(20):219,561. 1976.]

3,933,031
SUBMARINE PIPELINE LEAK LOCATOR OR THE LIKE
William J. Uhlarik, Monterey Park, Calif., assignor to International Telephone and Telegraph Corporation, New York, N.Y.
Filed Dec. 18, 1974, Ser. No. 533,806
Int. Cl.² G01M 3/28
U.S. Cl. 73—40.5 R 10 Claims

C-1444-76
THE RESPONSE OF THE OIL INDUSTRY TO THE PROBLEMS OF POLLUTION OF THE SEA FROM SHIPS

Walder, C.A. 1975.
Petroleum and Environmental Conservation. International Petroleum Industry Environmental Conservation Association, 1975. p.199-213.

Regulations, Pollution prevention, Tankers, International conventions, Petroleum industry

Numerous environmental safety and oil pollution prevention measures which have been adopted by members of the Oil Companies International Forum are outlined. This group controls the majority of the world's oil tanker fleet. Its objectives include the safe handling and transport of oil at sea, prevention of collisions, control of operational and accidental oil discharges at sea and at terminals, improved personnel training, and compliance with provisions of the 1973 International Convention for the Prevention of Pollution from Ships.

[from Pollution Abstracts7(2):76-01304. 1976.]

C-1445-76
THE ROLE OF THE U.S. COAST GUARD IN POLLUTION PREVENTION, PORT SAFETY, AND SHIP CONSTRUCTION

Wood. 1975.
Society of Naval Architects and Marine Engineers, Hampton Roads, local section paper.

Pollution prevention, Ports, Tankers, Ships

Summary not avilable. (May be purchased from SNAME, 74 Trinity Place, New York, N.Y. 10006.)

[from Marine Technology 12(4):471. 1976.]

C-1446-76
MARINE TRANSPORTATION OF CRUDE OIL AND PRODUCTS

Yamji, S. 1975.
World Petroleum Congress, 9th, Tokyo, 1975. Review paper 10.

Oil transport, Crude oil, Tankers, Environmental protection

Many aspects of marine transport of crude oil and petroleum products are discussed, including environmental conservation procedures and safer navigation of tankers and ships.

[from Fuel Abstracts 17(3):#1539. 1976.]

5. DESIGN AND ENGINEERING

C-1447-76
POLLUTION ENGINEERING PRACTICE HANDBOOK

Cheremisinoff, P.N., and R.A. Young. 1975.
Ann Arbor, Michigan, Ann Arbor Science Publishers, 1975. 1073p.

Manuals, Guidelines, Oil spills, Waste oil disposal, Wastewater treatment

The purpose of this handbook is to furnish engineers, managers, and students with guidance and direction in the field of pollution engineering. Pollution-related techniques, methods, equipment, and systems are assessed. Chapter 17, "Pollution from Oil Spills" covers topics of oil waste disposal, oil spill control, oil spill monitoring, and treatment of oily and metal-containing wastewater.

C-1448-76
HANDBOOK OF MARINE ENVIRONMENTAL ENGINEERING

Cross, F.L., Jr. 1974.
Westport, Connecticut, Technomic Publishing Company. 1974. 186p.

Manuals, Oil spills, Wastewater treatment, Bilges, EIS

Among the pollution problems considered are air pollution control, oil and hazardous materials spills, sewage treatment, industrial wastewater and solid wastes. Effects of bilge washing, legal considerations, and environmental impact statements for marine operations are also reviewed.

C-1449-76
FINITE-ELEMENT ANALYSIS AND OPTIMIZATION OF A WEB FRAME OF A TANKER WITH ISOLATED BALLAST SYSTEM

Finifter D., and A. Mansour. 1974.
Journal of Ship Research 18(2):85-95.

Tankers, Segregated ballast

The discharge of tanker ballast water which has been contaminated by oil residue in the tanks is a source of oil pollution which can be avoided. "Finite-element analysis was used in the design of an unconventional tanker web frame which satisfies certain requirements stipulated by an isolated ballast system. The weight of the frame was minimized using an optimality criterion based on a fully stressed design."

C-1450-76
DESIGN OF AN ENVIRONMENTALLY ACCEPTABLE DRILLING FLUID

Hayatdavoudi, A. 1976.
Offshore Technology Conference, 8th, Houston, 1976. Paper no. OTC-2616. Abstract.

Offshore drilling, Toxicity, *Drilling fluid, Environmental protection

A drilling fluid, which is based on a non-ionic, non-toxic, water soluble, cellulose derivative, has been developed. The fluid has highly desirable drilling characteristics and can be used as an environmentally acceptable drilling medium for offshore applications.

C-1451-76
DESIGN CONSIDERATIONS FOR A BACKOFF RAM FOR USE IN A BLOWOUT PREVENTER

Helfer, P.F., and M.R. Jones. 1975.
American Society of Mechanical Engineers Meeting, Sept. 21-25, 1975. Paper no. 75-Pet-13. 5p.

Blowout prevention, *Rams

This paper examines the factors considered in designing, constructing and testing sets of blowout preventer rams able to engage and rotate a pipe extending through the blowout preventer's vertical bore. Test results of the reliability of the rams are presented.

[from Engineering Index Monthly 14(1):#004300. 1976.]

C-1452-76
EVALUATION OF MEMBRANE OIL POLLUTION PREVENTION SYSTEM RESEARCH CONDUCTED FOR THE UNITED STATES COAST GUARD AND THE UNITED STATES NAVY

Hochrein, A.A., Jr. J.D. Helm, and A.P. Thiruvengadam. 1975.
Final report, USCG-D-175-75, contract DOT-CG-52312. 70p.

Pollution prevention, Ballast, Oil-water separation

Problems associated with the dynamic response of membrane configurations were evaluated under simulated operating conditions. Neoprene-nylon-nitrile elastomer has been determined to be the best material for the membrane. Evaluation of the material's physical properties indicates that the elastomer can withstand abrasion, oil immersion, creasing, wrinkling and pressure fluctuations.

[from Government Reports Announcements 76(4):#AD-A018 945/6GA. 1976.]

C-1453-76
VARIABLE INSIDE DIAMETER BLOWOUT PREVENTER

LeRouaz, R.K. 1976.
Canadian Patent 983,390

The blowout preventer consists of a pair of variable inside diameter blowout preventer rams each equipped with metallic anti-extrusion means that prevent longitudinal extrusion of yieldable sealants. With this device the well bore may be sealed off even at high well pressures. Certain other operation, such as high pressure stripping of pipe during removal from the well, are readily accomplished with the blowout preventer.

[from Petroleum Abstracts 16(12):217,554. 1976.]

C-1454-76
METHODS AND APPARATUSES FOR CONTROLLING AND PREVENTING BLOWOUTS IN WELLS

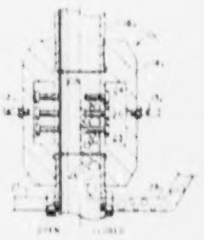
McCall, R.H. 1975.
U.S. Patent 3,926,256

Blowout prevention, Oil wells, Offshore drilling

A method and remote control device are detailed which control flow and prevent blowouts in offshore wells. The device consists of several pins which are extendable into a flow chamber that interconnects two tubing ends. With pins extended, the flow chamber catches sealer material introduced below the chamber, forming an impenetrable plug until the pins are retracted to restore fluid flow.

[from Petroleum Abstracts 16(13)L#218,835. 1976.]

3,926,256
METHODS AND APPARATUSES FOR CONTROLLING AND PREVENTING BLOW-OUTS IN WELLS
Richard H. McCall, Houston, Tex., assignor to Texaco Inc., New York, N.Y.
Division of Ser. No. 383,867, July 30, 1973, abandoned. This application Dec. 9, 1974, Ser. No. 530,782
Int. Cl.^{2} F21B *33/035, 35/00*
U.S. Cl. 166 — 285 **10 Claims**



C-1455-76
REFINERY DESIGN AND OPERATIONS IN THE SEVENTIES

Mill, J.G., and J.A. Bunn. 1975.
World Petroleum Congress, 9th, Tokyo, 1975. Review paper 8.

Refineries, Economic effects, Regulations

New developments in refinery design reflect not only the recent higher basic energy costs, but also the costs of more stringent environmental regulations. The paper discusses available alternatives in refinery design appropriate to these new conditions.

[from Fuel Abstracts 17(3):#1560. 1976.]

C-1456-76
COANDA EFFECT OIL-WATER SEPARATOR

Paszyc, A.J., J.B. Curry, and D.R. Pal. 1974.
U.S. Patent Application, AD-D001 437/3

Oil-water separation

An oil-water separating device is described which uses the wall attachment effect for separating oil from an oil-water mixture in a continuous manner. The patent application relates particularly to oil-water separators which use centrifugation.

[from Government Reports Announcements 76(4):#PAT-APPl-551 906/6A. 1976.]

C-1457-76
JANE'S OCEAN TECHNOLOGY. 1974-54

Trillo, R.S. 1974.
New York, Franklin Watts, Inc., 1974. 344p.

Information systems, Offshore exploration, Oil spills

This yearbook covers the technology of underwater exploration and engineering. Detailed information is provided for submersibles and their support vessels, underwater habitats and vehicles, research vessels, drilling ships, oil spill technology, etc. Research organization and institute profiles are also provided.

[from Sea Frontiers 22(2):124. 1976.]

C-1458-76
THE COPENHAGEN OFFSHORE CRAFT CONFERENCE

Troup, K.D. (ed.). 1975.
London, Thomas Reed Industrial Press Ltd, 1975. 220p.

Cleanup, Recovery, Oil spills

The conference deals with many aspects of marine and naval engineering and development. Included among these topics are papers on oil pollution control techniques.

[from Oceanic Abstracts 13(1):#895. 1976.]

C-1459-76
SHEAR RAMS FOR BLOWOUT PREVENTERS

Vujasinovic, A.N. 1975.
American Society of Mechanical Engineers Meeting, September 21-25, 1975. Paper no. 75-PET-8. 12p.

Blowout prevention,*Shear rams

The development of Rucker Shaffer shear rams for blowout preventers is reviewed.

[from The Engineering Index Monthly (14)1:#004299. 1976.]

6. WASTE OIL AND WASTEWATER TREATMENT

C-1460-76

TREATMENT OF WASTE WATERS CONTAINING EMULSIFIED OILS

Adachi, Y. 1975.
Japanese Kokai (unexamined patent application) 75,116,369

Wastewater treatment, Oil-water separation, Emulsions

Wastewater with emulsified oils are first adjusted to pH 9-12 with CaOH, and AL+ and Fe+ salts are added. The mixture is then stirred and aerated at high pressure. Sudden reduction of pressure causes the oils to demulsify and float to the surface. The process is applicable to the petroleum processing industry.

[from Chemical Abstracts 84(12):#79365p. 1976.]

C-1461-76

INDUSTRIAL AND MUNICIPAL SLUDGE DEWATERING. BOEING BEST [BOEING EXTRACTIVE SLUDGE TREATMENT] SYSTEM

Ames, R.K., H.H. Peters, and R.L. Olson. 1974.
Engineering Bulletin of Purdue Univeristy, Engineering Extension Series 145(part 1):207-212.

Wastewater treatment, Oil-water separation, Sludge, Solvents, Distillation

The BEST method mechanically filters out most solids and effectively removes oils by the use of certain amine solvents followed by distillation. This process results in three fractions: recovered oils (and fats), clear and sterile water effluent, and a sterile, odorless and colorless cake that is useful as soil conditioner and fertilizer.

[from Chemical Abstracts 84(12):#79764e. 1976.]

C-1462-76

API, REFINING DEPARTMENT, MIDYEAR MEETING, 40TH, CHICAGO, 1975

Anon. 1975.
Proceedings American Petroleum Institute Section III Refining.
Washington D.C., American Petroleum Institute, 1975. Vol. 54. 563p.

Wastewater treatment, Refineries, Solid waste, *Safety aspects LNG

This symposium of 35 papers includes wastewater improvement, current corrosion problems, refinery odors, pressure vessels and tanks, refinery solid waste disposal, safety aspects of LNG, and current processing trends.

[from The Engineering Index Monthly 14(1):#004560. 1976.]

C-1463-76
BRITISH COLUMBIA WATER AND WASTE ASSOCIATION, ANNUAL CONFERENCE: PROCEEDINGS

Anon. 1975.
Ottawa, Ontario, Canada. British Columbia Water and Waste Association, 1975. 263p.

Wastewater treatment, Oil spills, Water quality, Groundwater

Among the topics covered in the conference are oil spill technology, wastewater and effluent treatment, and groundwater protection.

[from Oceanic Abstracts 13(1):#660. 1976.]

C-1464-76
CONCRETE BARGE HOUSES GRAVITY OIL/WATER SEPARATOR (news brief)

Anon. 1976.
Ocean Industry 11(5):88.

Wastewater treatment, Oil-water separation, Offshore production, Recovery

A mobile, floating, concrete barge has been designed for the separation of oil from wastewater which is produced in offshore oil production. The barge has a series of flow channels and baffles designed to allow oil to rise to the surface and separate from the waste brines. The oil is then recovered and channelled into the crude oil pipeline for sale.

C-1465-76
OILY WATER SEPARATOR (product information)

Anon. 1976.
Offshore 36(3):166.

Wastewater treatment, Oil-water separator, Bilges

The model PM-1100 series from Velcon Filters, Inc. purifies bilge or other oily water to within EPA and USCG "clean water" limits. Two models are available, one rated at 19 l/min and one at 38 l/min.

C-1466-76
POLYMERS IN COALESCER-FILTER REMOVE OIL FROM BILGE WATER (new brief)

Anon. 1976.
Sea Technology 17(3):36.

Wastewater treatment, Bilges, Tankers

A chemist at the Naval Research Laboratory has found that the use of polymers in bilge filter systems could increase the effectiveness of the coalescer filter's ability to remove oily waste and decrease the amount of pollution released into the ocean.

C-1467-76
RANGE OF PRODUCTS TO REDUCE OIL EFFLUENT LEVELS ANNOUNCED

Anon. 1975.
Australian Chemical Engineering 16(6):14.

Wastewater treatment, Oil-water separation, Adsorption

The article describes a full range of products offered by Tecalemit Pty. Limited, Australia. All of the products use a modified form of urea formaldehyde (CDA) which has unique oil adsorbing properties. These CDA products are offered in the form of flaked or solid foams, hand cleaners, filters and strainer traps, all of which effectively remove hydrocarbon contaminents.

[from Selected Water Resources Abstracts9(6):#2579. 1976.]

C-1468-76
SYSTEM HANDLES OILY WATERS ON SMALL VESSELS (product information)

Anon. 1975.
Marine Engineering/Log 80(7):64.

Wastewater treatment, Ships, Bilges, Design and engineering

The Mini-Marine Discharge Control System is designed to enable small ships and workboats to control discharges of oily bilge and ballast waters. The system meets U.S. Coast Guard requirements for bilge waters and will deliver an effluent of less than 15 ppm oil. The system includes filtration, separation units, effluent monitors and an alarm. FFI contact the Keene Corporation's Fluid Handling Division.

C-1469-76
WHAT, ME WORRY? (news brief)

Anon. 1976.
Environmental Action 7(22):15.

Waste oil disposal, Recycling, Legislation

The environmental problem of waste oil treatment and disposal is considered. Two problems hindering the development of recycling methods for used oils are that waste oil is taxed to make it more expensive than virgin oil, and that re-refined oil must be labeled "made from previously used oils", which makes the product less appealing to motorists. Recycling and disposal problems will remain to be serious problems until Congress passes new legislation.

C-1470-76
TREATMENT OF WASTEWATER CONTAINING METALS AND EMULSIFIED OILS

Ariyama, K. and S. Sasaki. 1975.
Japanese Kokai (unexamined patent application) 75,155,053

Wastewater treatment, Oil-water separation, Emulsions, Flocculation

In wastewater containing metals and emulsified oils, the oil is removed first by the addition of an inorganic flocculant and treatment with tannins at about pH 6.5. The flocs are removed, and the remaining tannin-containing liquid is adjusted to over pH 9 to precipitate the metals.

[from Chemical Abstracts 84(22):#155334v. 1976.]

C-1471-76
SEPARATION OF ESP. [sic] OIL IN WATER EMULSIONS

Author unknown. 1975.
French Patent 2,248,068

Oil-water separation, Wastewater treatment, Design and engineering, Adsorption

The patent describes an oil/water separator in which contaminated liquid is passed through a housing packed with compressed sorbing and coalescing media. The sorbing medium is made of microfibers of ethylene, propylene or styrene polymers; the coalescing medium consists of glass fibers.

[from Selected Water Resources Abstracts 9(6):#02975. 1976.]

C-1472-76
TREATMENT OF WASTE WATERS BY ELECTROLYSIS

Ayuzawa, S., K. Tsuchiya, and K. Taira. 1975.
Japanese Kokai (unexamined patent application) 75,151,772

Wastewater treatment, Oil-water separation, *Electrolysis

Oils, organic matter, and heavy metals are removed from wastewater by an eletrolytic process in which the pH is maintained between 3.5 and 6.5. The oil content of wastewater was reduced from 10,000 ppm oil to 1 ppm oil after electrolytic treatment.

[from Chemical Abstracts 84(22):#155 342w. 1976.]

C-1473-76
OCEAN DISPOSAL OF LIQUID PETROCHEMICAL WASTES

Ball, J., and T.D. Reynolds. 1974.
Annual Conference of the Marine Technology Society, 10th, 1974.
p.97-106.

Waste oil disposal, Petrochemicals, Dispersions

Presented in this paper is a reevalution of the data from previous case histories of ocean disposal of liquid petrochemical wastes. A basic dilution equation that adequately describes the waste dispersion from each of the dumping studies is developed.

[from MRIS Abstracts 12:#098188. 1976.]

C-1474-76
IMPROVEMENTS IN WASTE TREATMENT METHODS AND PLANTS

Blows, D.G., and R.J. Davies. 1975.
British Patent 1,419,944

Waste oil disposal, Ships, Incineration, Design and engineering

A compact waste disposal plant, based on a fluidized bed incinerator, has been developed for use on ships or in isolated locations. The unit will combust sewage sludge, waste fuel, and waste oil, and discharge clear liquid and sterile ashes.

[from Chemical Abstracts 84(18):#126525c. 1976.]

C-1475-76
REMOVAL OF OIL FROM DILUTE AQEOUS EMULSIONS BY AUTOCOACERVATION AND COALISCENCE ON CARBON-METAL GRANULAR BEDS

Brown, W.P., and M.M. Ghosh. 1974.
Engineering Bulletin of Purdue University, Engineering Extension Service 145(part 1):357-369.

Wastewater treatment, Oil-water separation, Emulsions, Coalescence

The article describes and evaluates a process wherein two dissimilar metals in contact and submerged in an aqueous medium form an electrochemical cell. Negatively charges oil droplets migrate to the anode and coalesce for separation from the water.

[from Chemical Abstracts 84(18):#126333p. 1976.]

C-1476-76
INCINERATE REFINERY WASTE ON A FLUID BED

Becker, K.P., and C.J. Wall. 1975.
Hydrocarbon Processing 54(10):88-93.

Waste oil disposal, Refineries, Incineration, Sludge, Emulsions

Fluid bed incineration is a practical, economical, and environmentally acceptable method for disposing of refinery waste sludges, including waste oil and water-oil emulsions. The article describes the technology, processes and meterials involved in an effective application of this method.

C-1477-76
REFINERY WASTEWATER TREATMENT AND REUSE

Bush, K.E. 1-76.
Chemical Engineering 83(8):113-118.

Refineries, Regulation, Wastewater treatment, *Primary treatment, *Second and tertiary treatment

The article reviews the rules and regulations governing effluent treatment processes and the latest technology in waste treatment processing for refineries. The unit processes are categorized as primary processes, which remove pollutants such as suspended solids and oils from wastewater before the water undergoes further treatment; and secondary and tertiary treatment processes, which improve the quality of wastewater to the point where it can be reused within the refinery.

C-1478-76
DISPOSAL OF WASTE WATERS

Centre National de Recherches Metallurgiques. 1975.
Belgian Patent 823,959

Wastewater disposal, Incineration

Wastewaters containing ≤ 70% of oils, other hydrocarbons and/or surfactants are incinerated by injection into coke at the beginning of the coke-quenching process. The organic materials are thermally cracked without releasing pollutant volatiles.

[from Chemical Abstracts 84(20):#140492w. 1976.]

C-1479-76
COALESCENCE OF EMULSIFIED WASTES BY FIBROUS BED

Chieu, J.N., R.S. Schechter, M.J. Humenick, and E.F. Gloyna. 1975.
Texas University Center Water Resources Technical Report CRWR-126.
183p.

Wastewater treatment, Coalescence, Emulsions

The feasibility of using a fibrous bed coalescer to separate emulsified oil from industrial waste streams and to evaluate system parameters was determined. Several types of coalescing media were used and four types of oily wastes were tested to determine the effect of fluid properties. Contact angle, interfacial tension and oil viscosity were measured for each system and the results were compared with the coalescer efficiency.

[from The Engineering Index Monthly 14(1):#003091. 1976.]

C-1480-76
MARINE POLLUTION CONTROL: PART III-SHIP DESIGN REQUIREMENTS; THE DESIGN APPROACH

Constant, A.E. 1975.
Naval Engineers Journal 87(10):47-55.

Design and engineering, Wastewater treatment, Ships, Bilges, Ballast

The article reviews and evaluates new, environmentally attractive developments in the design and engineering of shipboard waste treatment facilities, including oily bilge and ballast water pollution control systems.

C-1481-76
COST-EFFECTIVE TREATMENT OF A PETROLEUM REFINERY EFFLUENT

Crame L.W. 1976.
American Petroleum Institute Refining Department Midyear Meeting, 41st, Los Angeles, 1976. Preprint no. 32-76. 17p.

Wastewater treatment, Refineries, Economic effects, Oil-water separation

Texaco recently conducted a series of studies at its west Tulsa, Oklahoma, refinery to develop a cost-effective method for treating and disposing of refinery wastewaters. The paper details the scope of these studies and discusses the technological and economic options available for refinery wastewater treatment modifications. On the basis of the studies, conversion to a rotating disk biological treatment system coupled with several modifications such as improvement of the oil-water separator system, was recommended and implemented.

C-1482-76
ACTIVATED CARBON IMPROVES WASTE WATER TREATMENT

DeJohn, P.B. and A.D. Adams. 1975.
Hydrocarbon Processing 54(10):104-107.

Waste oil disposal, Refineries, Adsorption, Activated sludge

The article describes how oily refinery wastes can be effectively adsorbed by the addition of activated carbon as a contact material in a treatment column, or as an additive in activated sludge systems.

C-1483-76
ECONOMIC IMPLICATIONS OF WASTEWATER EFFLUENT GUIDELINES FOR PETROLEUM REFINING

Denbo, R.T. 1975.
American Petroleum Institute Refining Department Midyear Meeting, 40th, Chicago, 1975. Washington, D.C., American Petroleum Institute, 1975. Section III, Refining. Vol. 54:31-35.

Guidelines, Wastewater, Refineries, Economic effects

A comparison is made of the relative impact of discharges, in terms of organic loading, from the nation's petroleum refineries and from municipalities and other industries throughout the U.S. Suggestions for corrections to Public Law 92-500, the Federal Water Pollution Control Act Amendments of 1972, are included.

[from Engineering Index Monthly 14(1):#004562. 1976.]

C-1484-76
FRESHWATER POLLUTION CONTROL IN REFINERIES

Eigenson, A.S., E.G. Ioakimis, and G.F. Oldham. 1975.
Petroleum and Environmental Conservation. International Petroleum
Industry Environmental Conservation Association, 1975. p.199-213.

Refineries, Wastewater treatment, Oil-water separation, Filtration,
Flocculation

Various methods of treating refinery wastewaters are compared, based on experience gained at numerous locations in the U.S.S.R., Europe and the U.S. Oil-water separation techniques such as filtration, flocculation and biological treatment are among the methods evaluated.

[from Pollution Abstracts 7(2):#76-01305. 1976.]

C-1485-76
TREATMENT OF CONTAMINATED WATER

Eurotecnia S.p.A. 1975.
German Offenlegungsschriften (unexaminedpatent application) 2,429,061

Wastewater treatment, Recovery, Hydrocarbons, Adsorption

A continuous process for removing hydrocarbons and other organic contaminants from water is described. The contaminated water is neutralized and passed through heat exchanges to a distillation column where certain hydrocarbons are condensed and burned and others are adsorbed.

[from Chemical Abstracts 84(20):#140469u. 1976.]

C-1486-76
OIL ADSORBENT

Fukatsu, K., J. Obata, K. Fukimo, and M. Ayabe. 1975.
Japanese Kokai (unexamined patent application) 75,137,887

Wastewater treatment, Adsorption, *Foam pellets

Oil adsorbent foam pellets are prepared by mixing a lipophilic thermoplastic resin with a foaming agent and forming pellets. These pellets have a greater oil adsorbing capacity than their non-foam equivalents and can adsorb several times their weight in oil.

[from Chemical Abstracts 84(18):#126508z. 1976.]

C-1487-76
AN OILY WASTE SEPARATOR SYSTEM

Garber, D.C. 1974.
Marine Technology 11(1):61.

Oil-water separation, Ships, Coalescence, Design and engineering

An oily-water separation system for shipboard use is described. The separator can handle any oily water mixture regardless of quantity or quality of oil components, ultimately yielding water having less than 10 ppm oil content.

C-1488-76
PROCESS MANAGEMENT APPROACH OF WASTEWATER TREATMENT TO MEET LOW HEXANE SOLUBLE REQUIREMENTS

Golber, M.B., and W.M. Throop. 1975.
Annual Pollution Control Conference, 3rd, 1975. V.W. Langworthy (ed.).
Ann Arbor, Michigan, Ann Arbor Science Publishers, 1975, p.449-465.

Wastewater treatment, Waste oil treatment, Oil-water separation, Lubricating oils

The management and treatment of waste motor and lubricating oils from a major maintenance garage are reviewed. Oily wastes are separated from the liquid effluent, removed and stored as a sludge, and periodically hauled away by an oil recycler (scavenger).

[from Pollution Abstracts 7(2):#76-01232. 1976.]

C-1489-76
REMOVAL OF EMULSIFIED OIL BY FILTRATION

Goto, Y., Y. Daigo, and M. Murata. 1975.
Japanese Kokai (unexamined patent application) 75,142,491

Waste oil treatment, Emulsions, Filtration, *Hydrophobic fibers

Oil is separated from oil emulsions by means of a filter which is prepared by adhering a hydrophobic synthetic fiber layer to porous materials consisting of polyethylene powder. This filter has high oil-removal efficiency; the concentration of oil in the resulting filtrate is reduced to < 5 ppm.

[from Chemical Abstracts 84(18):#12651a. 1976.]

C-1490-76

FLOCCULATION OF WASTE WATERS FROM PETROLEUM REFINERIES

Hade, A., and A. Elcabetz. 1975.
Water Pollution Research Canada (9):302-314.

Wastewater treatment, Refineries, Flocculation, Coagulation

Various parameters which affect the rates of destabilization, coagulation and flocculation in petroleum refinery wastewaters were investigated. The conditions which promote and optimize flocculation are evaluated.

[from Chemical Abstracts 84(22):#155207f. 1976.]

C-1491-76

GRANULATING AGENT FOR OIL

Hirate, H., U. Ichikawa, Y. Takenaka, T. Morishita, and I. Fujimoto. 1975.
Japanese Kokai (unexamined patent application) 75 60,482

Wastewater treatment, Oil-water separation, Emulsions, Coalescence

Oil emulsions can be removed from water by passing the oil-water mixture through pressed polyester fiber webs having specific dimensions and denier. In a specific example, water containing 1000 ppm heavy oil emerged from the web with an oil content of 0.8 ppm.

[from Chemical Abstracts 84(20):#140451g. 1976.]

C-1492-76

ADSORBER FOR REMOVING OIL FROM WATER

Ikemoto, S.H. Segawa, Y. Ueda, and J. Ohtaki. 1975.
Japanese Kokai (unexamined patent application) 75 62,867

Wastewater treatment, Oil-water separation, Adsorption

Oily wastewater is repeatedly passed through tower(s) packed with oil adsorbent synthetic fibers and pulp which agglomerate the oil. The agglomerated oil is continuously siphoned off the top of the adsorption tower by a bundle of lipophilic polypropylene fibers. This process reduces oil content to a few parts per million and greatly prolongs the useful life of the oil adsorbent materials.

[from Chemical Abstracts 84(12):#79343e. 1976.]

C-1493-76
OIL SOLIDIFIERS AND SPILLED OIL TREATMENT

Imamura, T., and K. Makabe. 1975.
Japanese Kokai (unexamined patent application) 75,105,567

Waste oil treatment, Oil spills, *Solidification

Oil floating on water can be solidified by treatment with $R^1R^2C:CXY_y$ (where X = CN, NO_2, carboxyl, or a C_{1-20} alkoxycarbonyl of H; and R^1 and R^2 = C_{1-20} aliphatic hydrocarbon, C_{1-20} alicyclic hydrocarbon, or phenol. The solidified oil is readily removed.

[from Chemical Abstracts 84(12):#79354j. 1976.]

C-1494-76
TREATMENT OF WASTE WATER CONTAINING DETERGENTS AND OIL

Iwata, F.
Japanese Kokai (unexamined patent application) 75 79,955

Wastewater treatment, Oil-water separation, Flocculation, Adsorption

In the process described, NaClO (or HClO) is added to inorganic flocculants and/or nonionic polymer flocculants and neutralizing agents in order to separate detergents and oil from water. The NaClO/HClO oxidizes the detergents, which then flocculate and float to the surface for easy removal. Similarly, the nonionic polymer flocculants adsorb the oil and allow it to be readily separated.

[from Chemical Abstracts 84(12):#79347j. 1976.]

C-1495-76
ENVIRONMENTAL CONSIDERATIONS IN THE DESIGN OF BALLAST WATER OUTFALLS
Johnston, C.S., and A.R. Halliwell. 1976.
Offshore Technology Conference, 8th, Houston, 1976. Paper no. OTC-2446. Abstract.

Wastewater treatment, Ballast, Oil discharges, Environmental protection, *Oil loading terminal

An oil loading terminal is being developed in the as yet environmentally unspoiled Orkney Islands, Scotland. Environmental considerations which were involved in the design of a ballast storage, treatment, and discharging facility in the terminal are detailed. Discharges from the facility will contain less than 10 ppm of oil, and such effluent will be discharged through a long outfall line at a depth of over 40 meters to prevent pollution.

C-1496-76
SURFACE CHEMISTRY PARAMETERS IN ECOLOGICAL CLEANUP OF OILY WASTEWATER

Kaufman, S. 1976.
Environmental Science and Technology 10(2):168-173.

Wastewater treatment, Oil-water separation, Ships, *Surface chemistry parameters

Current technology employs coalescer filters composed of glass fibers and resinous binders to separate oil from wastewater that accumulates on ships. Surfactants in the effluent, however, have been found to interfere with separation. Six solid substrates, five typical oils, seawater, distilled water, two military specification detergent formulations, and one non-specific detergent formulation were studied in combination; surface chemistry parameters were observed. Glass and the binders were the least effective substrates for separation, while polypropylene and polytetrafluoroethylene were the most effective.

C-1497-76
TREATMENT OF WASTE WATERS CONTAINING EMULSIFIED OIL

Kawamata, T., and Y. Kudo. 1975.
Japanese Kokai (unexamined patent application) 75,117,251

Wastewater treatment, Oil-water separation, Emulsions, Flocculation

"A polysaccharide flocculant aid containing galactomannan and a polysaccharide consisting of glucose, mannose, glucuronic acid and pyruvic acid, and a cationic organic flocculant are added to a wastewater containing emulsified oil; the emulsified oils are demulsified and float to the surface, leaving large filamentations flocs with high filtrability in the aqueous fractions."

[from Chemical Abstracts 84(22):#155318t. 1976.]

C-1498-76
WASTE OIL RECOVERY AND DISPOSAL

Kimball, V.S. 1975.
Pollution Technology Review (20). 279p.

Waste oil disposal, Recovery, Recycling, Reuse

The sources and characteristics of waste oil and existing or proposed methods for recovery and reuse are detailed. Specific recycling and disposal practices, such as road oiling, incineration, and combination with fuel oil are also covered.

[from Petroleum Abstracts 16(11):#217,425. 1976.]

C-1499-76
REMOVAL OF WATER SOLUBLE ORGANIC MATTERS FROM WASTE WATER

Kinbara, K., and M. Ikeda. 1975.
Japanese Kokai (unexamined patent application) 75 85,583

Wastewater treatment, Flocculation, Oil-water separation, Filtration

Oily waste water containing water-soluble organic matter is treated with water-soluble, anionic, cycloorganic compounds, and oil flocculants or other oil treatment agents. This is followed by membrane filtration, which separates the oil and organic matter from the water.

[from Chemical Abstracts 84(20):#140444g. 1976.]

C-1500-76
DEMULSIFICATION OF OIL EMULSION IN WASTE WATERS WITH AIR BUBBLES AND HIGH-MOLECULAR-WEIGHT FLOCCULENTS

Kondo, G. and M. Asakura. 1975.
Japanese Kokai (unexamined patent application) 75 39,673

Wastewater treatment, Oil-water separation, Emulsions, Flocculation

The wastewater is adjusted to a weakly acidic pH, and a small amount of a high-molecular-weight flocculent is added to increase the association effect of air bubbles on fine oil droplets for oil-water separation.

[from Chemical Abstracts 84(10):#65007m. 1976.]

C-1501-76
USE OF WASTE WATER FROM PETROLEUM WELLS FROM THE STANDPOINT OF ENVIRONMENTAL PROTECTION AND MAINTENANCE OF WELL PRESSURE (English summary)

Liszka, K., Z. Koehsling, and J. Jewulski. 1975.
Zeszyty Naukowe Akademii Gorniczo-Hutniczej Cracow, Gornictwo no. 69. p.7-18.

Oil wells, Wastewater treatment, Wastewater disposal, Recycling

The article describes the technology and methods used in a purification plant that treats up to 5000 m^3/day of oil well wastewaters, so that these waters can be safely discharged into the environment or recycled by pumping back into the oil well.

[from Chemical Abstracts 84(16):#108103j. 1976.]

C-1502-76
APPARATUS AND METHOD FOR PURIFYING WASTE WATER CONTAMINATED WITH OIL, GREASE, WAX, OR SOLVENTS

Maier, D. 1975.
German Offenlegungsschriften (unexamined patent application) 2,402,527

Wastewater treatment, Oil-water separation, Flocculation, Filtration

Finely divided flocculants are added to wastewater passing through a high pressure fluid jet washing apparatus. Oil, wax, grease or solvents combine with the flocculants on contact, and the resulting flocs are separated or filtered from the water. Temperature and pH can be adjusted to optimize the process.

[from Chemical Abstracts 84(16):111346w. 1976.]

C-1503-76
REMOVAL OF SOLUBLE OILS FROM WATER

Mail, I. 1975.
Canadian Patent 970,486

Wastewater treatment, Oil-water separation, Flocculation, Flotation

"Water soluble oils containing hydrophilic groups are removed from waste by the addition of a polyvalent cation (e.g. Al^{3+}) to form a colloidal grease, precipitation of the hydroxide salt by pH adjustment, addition of a polyelectrolyte to flocculate the colloid, and removal of the floc by entrainment with air and flotation."

[from Chemical Abstracts 84(16):#111343t. 1976.]

C-1504-76
SEPARATION OF EMULSIFIED LIQUIDS

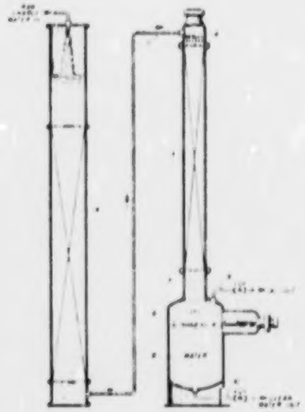
Mail, I.P. 1975.
U.S. Patent 3,919,081

Wastewater treatment, Oil-water separation, Emulsions, Coalescence

A process for separating emulsified liquids is described which is especially useful for separating liquid hydrocarbons from their emulsion with water on an activated carbon bed. The emulsion is passed through a preferentially wettable solid bed so that the dispersed liquid coalesces into droplets large enough to be collected and removed.

[from Chemical Abstracts 84(22):#152750s. 1976.]

3,919,081
SEPARATION OF EMULSIFIED LIQUIDS
Issac P. Mail, Tulsa, Okla., assignor to Combustion Engineering, Inc., New York, N.Y.
Continuation of Ser. No. 87,526, Nov. 6, 1970, abandoned. This application Sept. 1, 1972, Ser. No. 285,713
Int. Cl.^{2} B01D *17/04*
U.S. Cl. 210—23 **5 Claims**



C-1505-76

TREATMENT OF WASTE WATERS DISCHARGED FROM PETROLEUM REFINING PROCESSES

Maitoko, T., T. Iwase, and M. Sato. 1975.
Japanese Kokai (unexamined patent application) 75 131,673

Wastewater treatment, Refineries, Oxidation

Wastewaters containing ≤ 100,000 ppm of organic or inorganic petroleum refinery wastes can be treated with high efficiency by a wet oxidation process which forms nontoxic products such as H_2O, CO_2 and neutral salts.

[from Chemical Abstracts 84(20):#140474s. 1976.]

C-1506-76
TREATMENT OF REFINERY WASTEWATER USING FILTRATION AND CARBON ADSORPTION

McCrodden, B.A. 1974.
Industrial Wastes Conference, 29th, West Lafayette, Indiana, 1974.
Pt 1:230-244. (Purdue University Engineering Bulletin, Engineering Extension Series No. 145.)

Refineries, Wastewater treatment, Design and engineering, Filtration, Adsorption

A detailed description of the devices, pilot plant and components, design data, analyses results, performance data and capital cost calculation is given.

[from Engineering Index Monthly 14(1):#004558. 1976.]

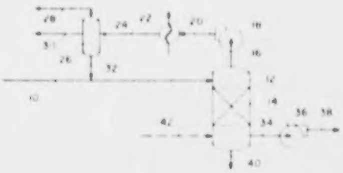
C-1507-76
VACUUM STRIPPING OF HYDROCARBON CONTAMINATED WATER STREAMS

McGill, J.C. 1975.
U.S. Patent 3,898,058

Wastewater treatment, Oil-water separation, *Vacuum stripping

In this process, applicable to sewage and oily effluent, the effluent stream is introduced at the top of a contacting vessel which contains such contacting devices and fractionation tower packing materials as Rashig rings and bubble fractionation trays. Hydrocarbon contaminants are removed by a vacuum pump aided by stripping gases and are then condensed and separated into gaseous and liquid fractions for removal.

3,898,058
VACUUM STRIPPING OF HYDROCARBON
CONTAMINATED WATER STREAMS
James C. McGill, Tulsa, Okla., assignor to H-T Management Company, Tulsa, Okla.
Filed Apr. 12, 1973, Ser. No. 350,311
Int. Cl. B01d *19/00*
U.S. Cl. 55—50 **12 Claims**



C-1508-76
REMOVAL OF OIL IN WATER

Miyamoto, H., and T. Miyamatsu. 1975.
Japanese Kokai (unexamined patent application) 75 61,389

Wastewater treatment, Oil-water separation, Adsorption

"The oil is adsorbed on fibers of < 100 microns diameter containing > 1.0 milli-equivalents/gram amino group below pH 12."

[from Chemical Abstracts 84(18):#126469n. 1976.]

C-1509-76
ACTIVATED SLUDGE TREATMENT OF PETROCHEMICAL WASTE WATER

Morita, S., and M. Masuda. 1975.
Yuki Gosei Kagaku Kyokai Shi 33(5):328-332.

Wastewater treatment, Petrochemicals, Activated sludge.

"A review with 1 reference."

[from Chemical Abstracts 84(14):#95058w. 1976.]

C-1510-076
FISH-INDUSTRY ASSESSMENT OF THE EFFECTIVENESS OF MODERN METHODS FOR TREATING WASTE WATERS OF PETROLEUM REFINERIES (English summary)

Mosevich, M.V. 1974.
Izvestiya Gosudarstvennoga Nauchno-Islledovatel'skogo Instituta Ozernogo i Rechnogo Rybnogo Khozaistva No.98 p.44-46.

Wastewater treatment, Refineries, Environmental effects, Fisheries

"A review with 4 references."

[from Chemical Abstracts 84(20):#140276d. 1976.]

C-1511-76
WASTE OIL: UNTAPPED ENERGY RESERVE

Myles, B. 1975.
National Parks and Conservation Magazine 49(8):18-19.

Waste oil disposal, Recycling, Reuse

Nearly 4.2 billion liters of used lubricating oils must find safe disposal each year. Dumping on land and in water has been reduced in recent years due to re-refining and the increase value of waste oils as fuel oil. The article briefly summarizes EPA recommendations for improving the collection, storage, transport and disposal of waste oils and outlines programs that would encourage recycling and reuse of oils.

C-1512-76
APPARATUS FOR PURIFYING OIL-CONTAINING WASTE WATER

Neukirchen, B. 1975.
German Offenlegungsschriften (unexamined patent application) 2,412,626

Wastewater treatment, Oil-water separation, Flocculation, Filtration, Design and engineering

Mechanical purification of oily wastewater by separation, flocculation, and filtration is carried out automatically in a flow-through system consisting of pumps, metering devices, a vacuum drum filter, and a storage tank, all contained in a portable housing.

[from Chemical Abstracts 84(16):#111351u. 1976.]

C-1513-76
POLLUTION-FREE WELL CUTTINGS DISPOSAL APPARATUS

N.L. Industries, Inc. 1975.
U.S. Patent 3,901,254

*Well cuttings disposal, Offshore drilling, Oil-water separation, Design and engineering

The patent relates to an apparatus and process for separating oil from drill cuttings produced in offshore drilling operations. The oily mud is separated by vibratory screening on a shaker platform. Oily cuttings are then discharged onto a cuttings washer and rinsed. The oily liquids are pumped to an oil-water separation system.

[from Underwater Information Bulletin 8(1):41-42. 1976.]

3,901,254
POLLUTION-FREE WELL CUTTINGS DISPOSAL APPARATUS
Marvin O. Stearns, London, England, and James A. Gill, Houston, Tex., assignors to NL Industries, Inc., New York, N.Y.
Filed Oct. 5, 1973, Ser. No. 403,999
Int. Cl. B08b *3/02, 15/00*
U.S. Cl. 134–104 **5 Claims**

C-1514-76
PETROCHEMICAL WASTE WATER TREATMENT USING ACTIVATED CARBON

Numasaki, K. 1975.
Yosui To Haisui 17(8):992-996.

Wastewater treatment, Petrochemicals, Adsorption, *Activated carbon

Activated carbon adsorption is effective in the removal of petrochemical wastes, especially if the wastewater has first undergone biological treatment. Also, the adsorption capacity of activated C increases with an increase in waste load.

[from Chemical Abstracts 84(20):#140336y. 1976.]

C-1515-76
TREATMENT OF WASTE WATER CONTAINING OILS

Okada, H., Y. Yasuda, S. Akimoto, M. Morita, K. Ikoma, and T. Ishi. 1975.
Japanese Kokai (unexamined patent application) 74 46,102

Wastewater treatment, Oil-water separation

Waste water is first acidified to pH 2-6 and heated to 60°C; then H_2O_2 is added and the mixture is neutralized. The neutralized mixture may be optionally treated by the activated sludge process to complete oil/water separation.

[from Chemical Abstracts 84(12):#79400w. 1976.]

C-1516-76
FLUIDIC OIL-WATER SEPARATOR

Paszyc, A.J., D. Pal, Kwang-ta Huang, and J.B. Curry. 1975.
U.S. Patent Application 549,245/GA.

Wastewater treatment, Oil-water separation, Design and engineering

This patent application relates to a continuous oil/water separation procedure and apparatus utilizing the Coanda Effect. The apparatus consists of a housing with inlet and outlet ports and a pair of offsetted, concavely curved walls. The entering oily water is split into two sub-jets, each of which enters a bounded region, wherein the oil is separated from the water and the water is discharged from the housing.

[from Government Reports Announcements 76(6):126. 1976.]

C-1517-76
WASTEWATER TREATMENT TECHNOLOGY

Patterson, J.W. 1975.
Ann Arbor, Michigan, Ann Arbor Science Publishers, Inc. v + 265p.

Wastewater treatment, Oil-water separation, Filtration, Coagulation, Flocculation, Precipitation, Biodegradation

The capabilities and limits of available wastewater treatment technologies are discussed for 22 major industrial pollutants, including oily wastes. In the chapter on oily wastes, primary treatment methods such as gravity separation and skimming are evaluated, and secondary treatment methods including flotation, filtration, coagulation, flocculation, precipitation and biological processes are compared.

C-1518-76
FACTORS INFLUENCING OIL REMOVAL EFFICIENCY IN DISSOLVED AIR FLOTATION UNITS

Pearson S.C. 1976.
Industrial Pollution Conferece, 4th, Houston, Texas, 1976. McLean, Virginia, Water and Wastewater Equipment Manufacturers Association, 1976. p.LII 1-LII-36.

Wastewater treatment, Oil-water separation, Refineries, Flotation, Emulsions

Dissolved air flotation is analyzed for its ability to remove persistent oil emulsions and other oily wastes from refinery wastewaters. The effects of various physical and chemical factors, such as pH, presence of contaminants, inorganic coagulants, flocculants, and adsorbents,on the efficiency and economics of the process are explored.

C-1519-76
SMALL BOAT OIL REMOVAL SYSTEM FOR BILGE WATER

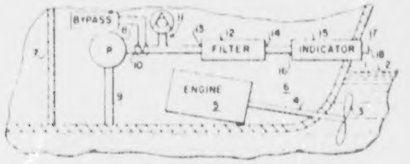
Pedone, V.S. 1975.
U.S. Patent 3,913,513

Wastewater treatment, Oil-water separation, Bilges, Filtration

A filtering system is described for separating relatively small quantities of oil from water. The filter contains alternate layers of large-particle and small-particle expanded resin (such as polyurethane). Such a filter is capable of picking up 50 to 70 times its own weight in oil without significantly changing its size. A visual indicator indicates when the filter system is full and should be replaced.

[from Selected Water Resources Abstracts 9(6):54,#02598a. 1976.]

3,913,513
SMALL BOAT OIL REMOVAL SYSTEM FOR BILGE WATER
Vito S. Pedone, Box 2733, Arlington, Va. 22202
Filed July 26, 1974, Ser. No. 492,168
Int. Cl.² B63B *29/16*
U.S. Cl. 114—183 R **18 Claims**



C-1520-76

PURIFICATION OF OIL CONTAINING WASTE WATER

Perna, Z. 1975.
German Offenlegungsschriften (unexamined patent application) 2,458,577

Wastewater treatment, Oil-water separation, Adsorption, *Magnetic Fe particles

Oily wastewater flows through a nonmagnetic pipe in which Fe particles are magnetically kept in suspension. The Fe particles adsorb the oil, thereby removing it from the water. A photocell monitors water purity so that when the particles are saturated by oil, the flow of waste water is diverted to a parallel pipe. The oil is removed from the particles and the particles are reused.

[from Chemical Abstracts 84(18):#126460c. 1976.]

C-1521-76

OPERATION AND PERFORMANCE OF A REFINERY WASTEWATER CARBON ADSORPTION PLANT

Prosche, M.A., G.G. Loop, and R.P. Strand. 1974.
Industrial Wastes Conference, 29th, West Lafayette, Indiana, May, 1974. Pt. 1. p.255-261. (Purdue University Engineering Bulletin, Engineering Extension Series No. 145.)

Refineries, Wastewater treatment, Adsorption, Design and engineering

The system selected consisted of impounding rain plus process water followed by activated carbon treatment to adsorb the COD material. The design and description of the plant are detailed.

C-1522-76
WATER POLLUTION AND ITS CONTROL AT OIL REFINERIES

Rao, and G.J. Mohan. 1975.
Indian Chemical Journal 10(2):XV-XXI.

Refineries, Wastewater treatment, Wastewater disposal, Pollution prevention

"The average total refinery wastewater properties from 12 refineries, pollution aspects of refinery, and treatment and disposal of refinery wastes are discussed."

[from Chemical Abstracts 84(18):#126374c. 1976.]

C-1523-76
BACTERIAL GROWTH AND DISPERSION OF CRUDE OIL IN AN OIL TANKER DURING ITS BALLAST VOYAGE

Rosenberg, E., E. Englander, A. Horowitz, D. Gutnick. 1975.
Symposium-Workshop on Impact of the Use of Microorganisms on the Aquatic Environment, Pensacola Beach, Florida, 1974. Bourquin, Meyers, and Ahearn (eds.). Corvallis, Oregon, Office of Research and Development, EPA, 1975. p.157-167. (U.S. Environmental Protection Agency Ecological Research Series, EPA-660/3-75-001).

Tankers, Wastewater treatment, Ballast, Bacteria, Emulsification

The report describes results of aerating and adding urea and K_2HPO_4 to oily ballast water in the compartment of an oil tanker. After four days the oil was emulsified and upon discharge of the treated water, no sign of oil was detected in the ship's wake. An untreated control compartment showed no significant oil dispersion. Also identified is bacterial-induced cleaning of oil tanks resulting from the activity of an emulsifying agent produced by the oil degrading bacterium Arthrobacter sp.

[from Aquatic Sciences and Fisheries Abstracts 6(1):#6Q575. 1976.]

C-1524-76
WASTE WATER DISPOSAL IN NAVIGABLE WATERS

Schlandt, W. 1975.
German Offenlegungsschriften (unexamined patent application) 2,423,871

Wastewater treatment, Ships, Oil-water separation, Reuse

The patent describes a process for collecting and shipbroad mixing of industrial wastewaters to produce harmless liquors that can be discharged after filtration and separation of oil and salts. The separated oil is then collected and used as fuel to propel the ship.

[from Chemical Abstracts 84(20):#140487y. 1976.]

C-1525-76
PETROLEUM REFINING GUIDELINES AND RELATED STUDIES

Simonsen, R.N. 1975.
American Petroleum Institute Refining Department Midyear Meeting, 40th, Chicago, 1975. Washington, D.C., American Petroleum Institute, 1975. Section III, Refining. Vol. 54. p.13-28.

Guidelines, Petroleum industry, Refineries, Wastewater treatment

The following are reviewed: an industry-wide raw waste load survey, a refinery activated sludge efficiency study, and a study on refinery effluent variability. Past and current guidelines pertaining to effluent treatment and disposal are discussed.

[from The Engineering Index Monthly 14(1):#004561. 1976.]

C-1562-76
SANITARY CHARACTERIZATION OF THE SARATOV RESERVIOR IN THE REGION OF AN OIL REFINERY (English summary)

Starodubtsev, E.D. 1974.
Gigiena Sanitariya (7):113-114.

Wastewater treatment, Refineries, USSR, *Saratov Reservior

Wastewaters entering a reservoir from an oil refinery complex were investigated before and after installation of biological treatment plants in 1971-1972. Overall pollution in the reservoir, including oily wastes, decreased significantly in the year treatment began.

[from Selected Water Resources Abstracts 9(5):33. 1976.]

C-1527-76

AN INTEGRATED POWER PROCESS MODEL OF WATER USE AND WASTEWATER TREATMENT IN OLEFINS PRODUCTION

Stone, J.C., A.K. Schwartz, Jr., R.A. Klein, F.D. Singleton, Jr., J.A. Calloway, and R.G. Thompson. 1975.

Final report, NSF/RA/E-75-032, PB-244 269/7; NSF Grant GI-134459. 271p.

Models, Wastewater treatment, Economic effects, Petrochemicals, *Olefins production

A model is described for evaluating the cost-effectiveness of a wastewater treatment system in an olefin production plant. Emphasis is placed on the treatment of organic pollutants, including oil.

[from Scientific and Technical Aerospace Reports 14(7):#N76-16657. 1976.]

C-1528-76

APPARATUS FOR REMOVING OIL FROM WATER

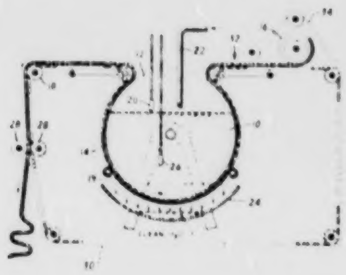
Sundin, G.H., F.H. Riedel, W.R. Niemi, and R.C. Slocumb. 1975.
U.S. Patent 3,915,859

Wastewater treatment, Oil-water separation, Design and engineering, Absorption

The patent relates to an apparatus for the continuous separation of oil from water. The oily water is introduced into a slowly rotating spool, which is wrapped with a fibrous sheet of oleophilic and water resistant material. As the oil is absorbed by the fibrous material, an automatic sensor activates a drive shaft which rotates the spool and advances new material into contact with oily water.

[from Selected Water Resources Abstracts 9(6):#02608. 1976.]

3,915,859
APPARATUS FOR REMOVING OIL FROM WATER
George H. Sundin, Duluth; Fred H. Riedel, Cloquet; William R. Niemi, Duluth, and Robert C. Slocumb, St. Paul, all of Minn., assignors to Conwed Corporation, St. Paul, Minn.
Filed Apr. 11, 1974, Ser. No. 459,915
Int. Cl.² B01D 33/04
U.S. Cl. 210—104 **15 Claims**



C-1529-76
BLOCK COPOLYMER OIL ABSORBENT FIBERS

Takahashi, R., T. Sone, and Y. Nagata. 1975.
Japanese Kokai (unexamined patent application) 75 50,279

Waste oil treatment, Absorption, *Block copolymer fibers

The application relates to a process for preparing block copolymer fibers, which are spun into mats and are highly effective in absorbing and retaining waste oil. The fiber mats are more effective than similar polypropylene fabrics.

[from Chemical Abstracts 84(18):#126446c. 1976.]

C-1530-76
TREATMENT OF ACIDIC WASTE SLUDGES FROM OIL REFINING PROCESSES

Takaoka, S. 1974.
Japanese Kokai (unexamined patent application) 74,126,701

Waste oil treatment, Sludge, Refineries, Recycling

The sludge is mixed with specific amounts of waste oil or light oil, then most of the H_2SO_4 in the mixture is extracted into water. The residual H_2SO_4 in the organic phase is neutralized with lime, and the organic phase is recycled as heavy oil or catalytically decomposed to give light oil.

[from Chemical Abstracts 84(10):#64998y. 1976.]

C-1531-76
TREATMENT OF WATERS CONTAINING OIL EMULSIONS

Tanaka, K. 1975.
Japanese Kokai (unexamined patent application) 75 131,871

Wastewater treatment, Emulsions, Oil-water separation, Flocculation

Flocculant mixtures made from organic bases and/or multivalent metal salts and nitrohumic acid are added to waters containing oil emulsions to separate the oils from the water. The method has a higher oil removal efficiency and produces less sludge than other flocculation methods.

[from Chemical Abstracts 84(20):#140475t. 1976.]

C-1532-76
TREATMENT OF OIL-CONTAINING WASTE WATER WITH LIGNIN DERIVATIVES

Tanaka, K., Y. Takahata, and M. Tamayama. 1975.
Japanese Kokai (unexamined patent application) 75 86,846

Wastewater treatment, Emulsions, Flocculation, Filtration

Flocculation of oils in wastewater or in oil emulsions is achieved with a mixture of lignin derivatives and either an organic base and/or a multivalent metal salt. The flocs are filtered out, leaving an aqueous filtrate containing only a few ppm of oil.

[from Chemical Abstracts 84(16):#11337u. 1876.]

C-1533-76
WATER QUALITY STUDIES IN PETROLEUM REFINERIES

Tertipis, G.G., and C.M. Pyburn. 1974.
Water Pollution Research in Canada 320-327.

Refineries, Wastewater treatment, Monitoring, Water quality

This study describes the general approaches to water quality and the efficiency of wastewater treatment facilities used by petroleum refineries. Field data collection for the study included the monitoring of effluents of several complex refineries, with emphasis on evaluating the performance of existing wastewater treatment units and new pilot plant units.

C-1534-76
RECENT TRENDS IN THE TECHNOLOGY OF OILY WASTE WATER TREATMENT

Minamide, Y. 1975.
Kagaku Kojo 19(4):73-77.

Design and engineering, Wastewater treatment, Waste oil treatment

The article reviews recent developments in equipment and methods used to treat waste oil. Processes discussed are electrolysis, adsorption, calcineration, and flotation with chemical coagulants.

[from Chemical Abstracts 84(12):#79216v. 1976.]

C-1535-76
OIL REMOVAL FROM REFINERY WASTES BY AIR FLOTATION

Volesky, B., and S. Agathos. 1974.
Water Pollution Research in Canada 9:328-339.

Wastewater treatment, Oil-water separation, Refineries, Flotation, Flocculation

Air flotation removes from 65% to over 90% of oily materials and suspended solids in wastewater; this percentage can be increased by using certain flotation and flocculation additives. The process can handle high-volume overload situations and can consistently deliver an effluent with less than 15 ppm total oil and suspended solids. Methods for further optimizing the process and limitations are also discussed.

[from Chemical Abstracts 84(12):#79275j. 1976.]

C-1536-76
APPARATUS FOR SEPARATING OIL-WATER MIXTURES

Weerts, W. 1975.
German Offenlegungsschriften (unexamined patent application) 2,423,010

Wastewater treatment, Oil-water separation, Absorption

"Oil-water mixtures are separated by passing through a tank filled with oil absorbing filter, such as Styropor powder cartridges."

[from Chemical Abstracts 84(22):#155324s. 1976.]

C-1537-76
FUNDAMENTALS OF ELIMINATING ORGANIC WATER POLLUTANTS WITH POLYETHYLENE (English summary)

Weil, L. and G. Greiner. 1974.
Vom Wasser 43:247-257.

Wastewater treatment, Oil-water separation, Crude oil, Hydrocarbons, *Polyethylene powder

Wastewater containing lipophilic contaminants such as crude oil and petroleum hydrocarbons were treated with polyethylene powder to produce potable water. This procedure was found to be far more effective in removing such pollutants than conventional flocculation or chemical treatment.

[from Selected Water Resources Abstracts 9(4):#W76-01555. 1976.]

C-1538-76
APPARATUS AND METHOD FOR SEPARATION OF LIGHT LIQUIDS FROM WATER ESPECIALLY WASTE WATER

Weiler, W. 1975.
German Offenlegungsschriften (unexamined patent application) 2,429,408

Wastewater treatment, Oil-water separation, Adsorption

Oil and petroleum products such as gasoline are removed from water by passage through tubes lined with hydrocarbon-oil selective materials.

[from Chemical Abstracts 84(20):#140498c. 1976.]

C-1539-76
SYSTEMS APPROACH TO POLLUTION-FREE PETROLEUM REFINERY

Yamaguchi, T. 1975.
World Petroleum Congress, 9th, Tokyo, 1975. Barking, Essex, England, Applied Science Publishers, 1975. Vol. 6. PD 24.

Wastewater treatment, Refineries

Summary not available.

[from Applied Science Publishers Brochure 1976.]

C-1540-76
TREATMENT OF OILY WASTEWATERS AND WASTE OILS

Yokota, K. 1975.
Yuki Gosei Kagaku Kyokai Shi 33(5):323-327.

Wastewater treatment, Waste oil treatment, Refineries, Tankers

"A review with 8 references of the application of emulsion breakers for the treatment of floating oils, oil dispersions, oil emulsions, and waste oils from iron and steel works, petroleum refineries, oil tankers, and machine tool workshops."

[from Chemical Abstracts 84(16):#111,111r. 1976.]

C-1541-76
SEPARATION OF OILS, SOLVENTS, AND LACQUERS FROM WASTE WATERS

Zeiss, O., and H. Linke. 1975.
German Offenlegungsschriften (unexamined patent application) 2,412,452

Wastewater treatment, Oil-water separation, Flocculation

Oils and other substances can be separated from waste waters by the admixture of 0.3-5 g/l of a dispersible carrier, such as a cellulose-containing material, and/or a starch derivative, and 0.003-0.5 g/l of a suitable flocculant.

[from Chemical Abstracts 84(16):111352v. 1976.]

7. RECLAMATION AND REUSE

C-1542-76
UTILIZATION OF BY-PRODUCTS AND WASTE PRODUCTS FROM PETROCHEMICAL OPERATION

Aghoramurthy, K., and A.K. Mendiratta. 1975.
Indian Chemical Journal 9(8):S3-S8.

Reuse, Petrochemicals

The utilization of by-products and waste products from petrochemical operations, including xylenes, glycols, and heavy paraffins is discussed.

[from Chemical Abstracts 84(10):#64893k. 1976.]

C-1543-76
REGENERATION OF USED LUBRICATING OILS

Audibert, F., G. Parc, and J.P. Peries. 1975.
French Demande 2,259,895

Waste oil treatment, Reclamation, Lubricating oils

A process is described wherein waste lubricating oils can be reclaimed by treating with water at 200°-500°C before using conventional H_2SO_4 and activated clay treatment. In an experiment, this method yielded a 92% recovery of finished oil of high purity.

[from Chemical Abstracts 84(16):#108320c. 1976.]

C-1544-76
PYROLYSIS SYSTEM AND PROCESS

Cheng, S-I. 1975.
U.S. Patent application SN-645503

Waste oil treatment, Reclamation, Crude oil, Solid waste, *Pyrolsis

A continuous feed process involving pyrolysis and gasification is described for the recovery of energy from solid waste and other wastes, including asphalt, naphtha and cheap crude oils.

[from Scientific Technical Aerospace Reports 14(7):#N76-16621. 1976.]

C-1545-76
RE-REFINING: ECONOMICALLY ATTRACTIVE WAY TO CONSERVE OIL

Cutler, E.T. 1976.
American Petroleum Institute Refining Department Midyear Meeting,
41st, Los Angeles, 1976. Preprint no. 30-76. 15p.

Waste oil treatment, Reclamation, Lubricating oil, Recycling

The need to recycle waste automotive lubricating oil and similar waste hydrocarbon oils is discussed, and the present disincentives to recycling are reviewed. Economic and technical details of a new re-refining process, the PVH (propane-vacuum-hydrogen) process are presented and advantages of the PVH process over other waste oil treatments and virgin lube oil refining are outlined.

C-1546-76
S.551: NATIONAL RECYCLING ACT

Domenici, Randolph, Williams, Fong, McGovern, Baker, McClure. 1975.
Congressional Record 121(15):S1430-1433.

Recycling, Legislation, U.S. government, Waste oil treatment, Waste oil disposal, Reclamation

This bill calls for federal and state regulations and programs to encourage the use of recycled oils. It calls for comprehensive regulations governing the collection, storage, transfer, disposal and reclamation of used oils. The act furthermore provides for the repeal of "previously used" and "reprocessed" oil labelling, requires licensing and record keeping by used oil collectors and recyclers, and requests annual reports by the EPA to Congress. The bill outlines enforcement procedures and penalties for violation or noncompliance of such regulations and laws.

C-1547-76
PROBLEMS FACING THE RE-REFINER

Emmerson, H.R. 1975.
Hydrocarbon Processing 54(9):145-148.

Waste oil treatment, Refining, Recycling, Regulations, Legislation

The number of re-refiners has decreased from 150 in 1960 to 40 in 1975 due to increasingly restrictive state and federal regulations and legislation, increased cost and difficulty in procurement of waste oils, increased quality demands for recycled oil, and the difficulty of removing metal contaminants and numerous complex additives from used oil. The article points out several legislative and technological possibilities that will help the re-refiner overcome such problems.

C-1548-76
FLEXICOKING-CLEAN PRODUCTS FROM DIRTY FEEDS

Griffel, J., G.E. Phillips, and J.C. Spry. 1976.
American Petroleum Institute Refining Department Midyear Meeting, 41st, Los Angeles, 1976. Preprint no. 40-76. 22p.

Reclamation, Crude oil, Extraction, *Flexicoking, *Residual oils

A recently developed thermal cracking process called FLEXICOKING is capable of converting undesirable high-metal, high-sulfur residual petroleum crudes into clean petroleum products and environmentally acceptable fuel gases. The paper describes and discusses the process, its economics, and its broad applicability to low grade feedstocks.

C-1549-76
REFINING OF WASTE OILS

Hayashida, R. 1975.
Japanese Kokai (unexamined patent application) 75,148,408

Waste oil treatment, Reclamation, Refining

A process is described for refining waste oils with suspended solids. The suspended solids are flocculated by a mixture of sulfonizable organic polymer and concentrated H_2SO_4. The process not only avoids oil charring and chemical decomposition inherent in the conventional H_2SO_4 process, but also greatly shortens the time required for flocculation and sedimentation of impurities.

[from Chemical Abstracts 84(22):#155341v. 1976.]

C-1550-76
PURIFIER FOR OIL

Henning, E. 1975.
Belgian patent 825,196

Waste oil treatment, Reclamation

The process described involves the use of a centrifuge apparatus operating under vacuum conditions to reclaim engine oils.

[from Chemical Abstracts 84(12):#76720. 1976.]

C-1551-76
APPARATUS FOR RE-REFINING USED PETROLEUM PRODUCTS

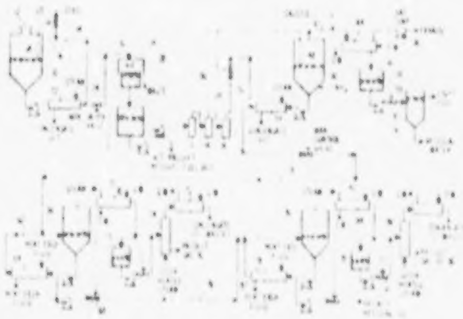
Hindman, G.J. 1975.
U.S. Patent 3,923,644

Waste oil treatment, Reclamation, Crankcase oils, Lubricating oil,
Fuel oil

A process is described for the reclamation of crankcase oils by flash vaporization with continuous recirculation of a portion of the unvaporized liquid. Successive filtration of the unvaporized liquid produces a fuel oil or, with additional refining by flash distillation, a lubricant oil.

[from Chemical Abstracts 84(18):#124320h. 1976.]

3,923,644
PROCESS AND APPARATUS FOR RE-REFINING USED PETROLEUM PRODUCTS
George J. Hindman, Pottstown, Pa., assignor to Petrocon Corporation, Valley Forge, Pa.
Filed Oct. 11, 1974, Ser. No. 514,176
Int. Cl.^{2} C10M *34/00*, **C10G** *33/00*, **C10C** *1/20*
U.S. Cl. 208—186 **7 Claims**



C-1552-76
RECLAIMING USED MOTOR OIL

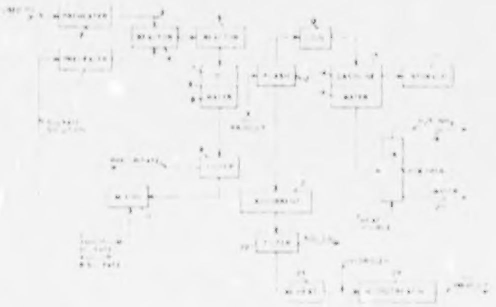
Johnson, M.M. 1976.
U.S. Patent 3,930,988

Waste oil treatment, Reclamation, Crankcase oil

Treatment of waste motor oil with aqueous $(NH_4)_2SO_4$, or NH_4HSO_4 reduces the ash content. Further reprocessing of such oil by an adsorbent and hydrotreating results in an oil with very few ash and trace metal impurities.

[from Chemical Abstracts 84(18):#124330m. 1976.]

3,930,988
RECLAIMING USED MOTOR OIL
Marvin M. Johnson, Bartlesville, Okla., assignor to Phillips Petroleum Company, Bartlesville, Okla.
Filed Feb. 24, 1975, Ser. No. 552,287
Int. Cl.^{2} C10M *11/00*, C10G *17/00*
U.S. Cl. 208—182 12 Claims



C-1553-76

REMOVAL OF LEAD AND OTHER SUSPENDED SOLIDS FROM USED HYDROCARBON LUBRICATING OILS

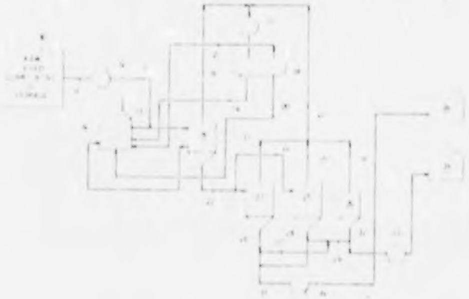
Lewis. R.W., T.A. Rodgers, and C.F. Goeking, Jr. 1975.
U.S. Patent 3,923,643

Reclamation, Lubricating oil, Waste oil treatment

A process for reclaiming used lubricating oil is described which removes at least 90% of the lead and other suspended solids from oil. Water and light hydrocarbons are first flashed off, and the suspended impurities are then agglomerated for removal by heat treatment of the oil at 500-700°C.

[from Chemical Abstracts 84(20):#138228w. 1976.]

3,923,643
REMOVAL OF LEAD AND OTHER SUSPENDED SOLIDS FROM USED HYDROCARBON LUBRICATING OIL
Robert W. Lewis, Houston; Thomas A. Rodgers, La Porte, and Charles F. Goeking, Jr., Pasadena, all of Tex., assignors to Shell Oil Company, Houston, Tex.
Filed June 14, 1974, Ser. No. 479,343
Int. Cl.^{2} C10M *11/00*
U.S. Cl. 208—179 5 Claims



C-1554-76

A JOINT VENTURE OF RECYCLING IN PLANT WASTE OILS

Oster, J.A. and G.T. Booth. 1975.
Automotive Engineering 83(10):n.p. Summary.

Waste oil treatment, Recycling, Lubricating oils

In recent times, the cost and availability of lubricating oil has become of prime importance to plant management. Re-refining is becoming generally accepted as a way of reducing costs and resolving liquid waste disposal problems.

[from Pollution Abstracts 7(2):#76-01525. 1976.]

C-1555-76

RECOVERY OF PETROLEUM OILS FROM WASTES

Ohkubo, T. 1975.
Japanese Kokai (unexamined patent application) 75 34,305

Waste oil treatment, Reclamation

Waste petroleum-based oils are first treated with alkalis, mixed with alcohols, polyglycols and/or polyglycol ethers, and then allowed to stand in order to separate oil from sludge.

[from Chemical Abstracts 84(12):#79333b. 1976.]

C-1556-76

REGENERATING WASTE PETROLEUM OILS BY EXTRACTING WITH LIGHT HYDROCARBONS TO REMOVE SLUDGE

Ohkubo. T. 1975.
Japanese Kokai (unexamined patent application) 75 46,705

Reclamation, Waste oil, *Extraction techniques

A petroleum waste oil (except lubricating waste oil) with or without alkali treatment is treated with a solvent containing $C_{>3}$ hydrocarbons and a separating agent (alcohols, polyglycols) to separate oils and sludge.

[from Chemical Abstracts 84(10):#62271g. 1976.]

C-1557-76
RECOVERY OF WASTE OILS

Tani, K. 1975.
Japanese patent 75,22,980

Lubricating oil, Reclamation, Waste oil treatment

This process for regenerating spent lubricating oils involves first mixing the oil with an aqueous base and a surfactant. The mixture is heated and agitated by blowing in steam for an hour. After cooling and standing, about 70% of the oil is recovered. The residue is then centrifuged. The process has a total recovery rate of 70-80%.

[from Chemical Abstracts 84(12):#76718. 1976.]

C-1558-76
RECYCLING OF WASTE POLYMERS AND OILS

Yamagami, Y. 1975.
Japanese Kokai (unexamined patent application) 75,150,669

Reclamation, Recycling, Crankcase oil, *Pyrolization

In this process, waste polymers (rubber and plastics) are combined and dissolved in waste oils, such as used crankcase oils. The polymer-oil solution is then pyrolized to yield usable gases, oils and asphalts.

[from Chemical Abstracts 84(22):#155347b. 1976.]

8. PERSONNEL TRAINING AND EDUCATION

C-1559-76
NATION'S FIRST UNIVERSITY RUN SPILL CONTROL SCHOOL UNDERWAY

Anon. 1975.
The University and the Sea 8(2):6-7.

Personnel training, Oil spills, Cleanup

Texas A & M University held its first session of oil spill control school on April 7-11, on the Moody College campus, Galveston. Twenty students representing various oil companies attended. The school trains participants to recognize potential spill situations and to organize and direct an oil spill cleanup effectively and within the legal framework. The five-day sessions are held every two weeks and are limited to 20 students.

[from MRIS Abstracts 12:#097507. 1976.]

C-1560-76
FIRST OIL SPILL CONTROL COURSE OFFERED BY TEXAS A & M

Oaks, K. 1976.
Offshore 36(5):228-230.

Personnel training, Pollution prevention, Oil spills, Cleanup, Contingency planning, Regulations

A five-day comprehensive course in oil spill control, which will be taught at least twenty times per year, has been developed by the Texas A & M University Engineering Extension Service. The course covers oil spills originating from onshore and offshore production and transfer and storage facilities. Classroom and field experience are included for all phases of spill prevention, containment, cleanup, recovery and disposal; and such topics as contingency planning, local, state, federal and international regulations and laws are considered.

9. CONTINGENCY PLANNING

C-1561-76
FISHERMEN CATCH OIL--IN EMERGENCIES

Anon. 1976.
Ocean Industry 11(3):35.

Oil spills, Alaska, Gulf of, Personnel training, Cleanup, *Port of Valdez

A 24-hour oil spill contingency plan is now in effect for the Port of Valdez marine tanker terminal presently under construction. The specially trained oil spill response crew of 10 men are all experienced native fishermen and boatmen from the Chugash Natives, Inc., and will be on call for the duration of the terminal's construction.

C-1562-76
NATIONAL OIL AND HAZARDOUS SUBSTANCES POLLUTION CONTINGENCY PLAN

Council on Environmental Quality. 1975.
Federal Register 40(28):6282-6302.

Oil spills, Pollution prevention, Government agencies

A comprehensive oil pollution contingency plan is presented which will cover navigable waters of the U.S., adjoining shorelines, the contiguous zone, and the high seas where a threat to U.S. waters, shoreline or shelf bottom exists. The plan is to provide a coordinated and integrated response from various governmental agencies and departments in case of an oil spillage or discharge emergency.

[from Petroleum Abstracts 16(20):#219,582. 1976.]

C-1563-76
OIL SPILL CONTROL. PART I. PREVENTION

D'Alessandro, P.L., Jr., and C.B. Cobb. 1976.
Hydrocarbon Processing 55(2), Section 1:121-124.

Oil spills, Pollution prevention, Personnel training

Oil spill control consists of prevention and counter-measures. A carefully developed and adequate oil spill prevention program of any company must include training, maintenance and inspection of critical systems, and upgrading or corrective measures whenever necessary.

[from Petroleum Abstracts 16(16):#218,662. 1976.]

C-1564-76
CONTINGENCY PLAN FOR SPILLS OF OIL AND HAZARDOUS MATERIALS FOR INLAND WATERS OF REGION III

Environmental Protection Agency. 1975.
EPA Reports Bibliography Quarterly, October-December, 1975. PB-244-959/3BE.

Oil spills, Inland, Guidelines, Cleanup

The report presents a detailed plan for the coordination of federal agencies having responsibilities in the cleanup, containment, and mitigation of spill incidents involving oil and/or hazardous substances.

C-1565-76
REGIONAL OIL AND HAZARDOUS SUBSTANCES POLLUTION CONTINGENCY PLAN REGION V. INLAND

Environmental Protection Agency. 1974.
EPA PB-237 540/0BE 147p.

Oil spills, Inland, Great Lakes

This plan provides a mechanism for coordinating response to an oil spill or other hazardous substances in the Great Lakes or its shores. It also provides methods of coordination between federal and state agencies and departments.

[from EPA Reports Bibliography Quarterly. Jan.-March 75. PB-242 075-01.]

C-1566-76
PLANNING, EQUIPMENT AND TRAINING FOR OIL SPILL CONTROL. 3RD ED.

Smith, Millard F. 1975.
Slickbar, Inc., Dept. PB, P.O. Box 139, Southport, CT. 06490. 98p.

Oil spills, Personnel training, Cleanup, Dispersants

The material on spill control planning, personnel training and equipment is updated in this edition and a chapter on potential uses of dispersants has been added.

[from Environmental Science and Technology 10(5):498. 1976.]

C-1567-76
THE NATIONAL STRIKE FORCE CONCEPT IN HAZARDOUS SUBSTANCE DISCHARGE RESPONSE ACTIVITIES

Williams, H.D. 1975.
International Symposium on Transport of Hazardous Cargoes by Sea and Inland Waterways, 4th, Jacksonville, 1975. 12p.

Personnel training, Oil transport, Oil discharges

The organizations, training, equipment and activities of the Coast Guard's National Strike Force are documented. Problems associated with the transport of hazardous substances other than oil are described.

[from MRIS Abstracts 12:#127079. 1976.]

C. EFFECTS OF OIL POLLUTION

1. BIOLOGICAL EFFECTS

C-1568-76
IMPACT OF PETROLEUM PRODUCTS ADDED TO AN ORGANIC SOIL ON MICROBIAL POPULATIONS AND PLANT UPTAKE OF ESSENTIAL ELEMENTS

Allerton, R.D. 1975.
Ph.D. Thesis, Ohio State University. 69p.

Biological effects, Microorganisms, Plants, Soil, Crude oil, Fuel oil

Crude oil and diesel fuel were used in the title study, and the following general results were reported: soil moisture and temperatures were higher than in control soils; microbial populations decreased after application of the petroleum products and returned to normal levels after 9 months; vegetation on oiled plots was stunted in comparison to that in control plots, but normal growth was apparent after 75 days.

[from Petroleum Abstracts 16(17):#218,911. 1976.]

C-1569-76
LABORATORY STUDIES ON THE EFFECTS OF OIL ON MARINE ORGANISMS: AN OVERVIEW

Anderson, J.W. 1975.
American Petroleum Institute Publication No. 4249. 70p.

Biological effects, Crude oil, Marine organisms

Summary not available.

[from Journal of the Marine Biological Association of the United Kingdom 56(1):132. 1976.]

C-1570-76
LIQUID MEMBRANES TRAP ASSORTED POISONS

Anon. 1976.
Science News 109(16):246.

Petrochemicals, Toxicity, Health hazards, *Liquid membranes

Recent research by Norman N. Li of Exxon Research and Engineering shows that poisoning from inorganic and organic toxic compounds, including petroleum products, can be effectively treated by liquid membrane systems. Other applications for liquid membranes include the selective separation of organic compounds, such as reclamation or upgrading of petroleum products.

C-1571-76
MOTORBOATS AND MARINE LIFE

Anon. 1976.
Science News 106(21):321-336.

Biological effects, Fuel oil, Mollusks

About 10% of the oil-fuel mixture in boat outboard motors is unburned and is leaked into the marine environment. Recent research shows that oysters and mussels exposed to hydrocarbon concentrations of about 50 ppm are damaged and many others die. Such concentrations could be approached in marinas and closed bays.

C-1572-76
PEREGRINE AND RAVEN POSSIBLY CONTAMINATED BY FULMAR OIL (news brief)

Booth, C.J. 1976.
British Birds 69(2):61.

Birds, Biological effects

The news brief describes observations of birds believed to have been contaminated by oil. Their ability to fly appeared to be severely impaired by an oily substance matting their feathers.

C-1573-76
MORPHOLOGY AND ULTRASTRUCTURE OF A PENICILLIUM SP. GROWN ON N-HEXADECANE OR PEPTONE

Cundell, A.M., W.C. Mueller, and R.W. Traxler. 1976.
Applied and Environmental Microbiology 31(3):408-414.

Hydrocarbons, Fungi, *Penicillium sp.

The study was designed to compare the morphology and ultrastructure of a Penicillium sp. when grown in liquid culture on n-hexadecane or peptone using transmission and scanning electron microscropy.

The fungus grew as hollow mycelial balls surrounding individual hydrocarbon droplets on n-hexadecane and as solid mycelial balls on peptone. Inclusions present in the hexadecane-grown mycelium were absent when the fungus was grown on peptone. These findings support the generality that hydrocarbons are sequestered in bacteria, yeast, and fungi.

C-1574-76
TOXICITY OF CRUDE OILS AND A DISPERSANT TO THE STONY CORAL MADRACIS MIRABILIS

Elgershuizen, J.H.B.W., and H.A.M. DeKruijf. 1976.
Marine Pollution Bulletin 7(2):22-25.

Cleanup, Oil spills, Toxicity, Crude oil, Dispersants, Coral reefs

In many areas, coral reefs are now exposed to oil and, subsequently, to dispersants when cleanup methods are used. The authors have concluded from their experiments that in a major oil spill the reefs are more endangered by the cleanup with chemical detergents than by the oil.

C-1575-76
THE MEDICAL SIGNIFICANCE OF MARINE POLLUTION BY ORGANIC CHEMICALS

Elias, P.S. 1975.
Proceedings of the Royal Society of London, Series B 189(1096):443-458.

Biological effects, Health hazards, *Organic pollutants

Toxicological information required for an assessment of the health hazards to man of organic pollutants in the marine environment is reviewed. An interpretation of these biological data is given. Examples of organic pollutants which pose a health hazard to man include the organomercury compounds, domestic sewage, pesticides, polychlorinated biphenyls, and petroleum and its derivative oils.

[from Toxicity Bibliography 8(4):#2331. 1976.]

C-1576-76
ACUTE TOXICITIES OF CRUDE OILS AND OIL DISPERSANT MIXTURES TO RED SEA FISHES AND INVERTEBRATES

Eisler, R. 1975.
Israel Journal of Zoology 24(1-2):16-27.

Toxicity, Crude oil, Dispersants, Fish, Invertebrates, Red Sea

Samples of Persian Gulf and Sinai crude oil and oil dispersants with surfactant and solvent fractions were tested for their toxicity to 10 different marine species, including teleosts, octocorals, crustaceans, mollusks and echinoderms. Fish and crustaceans were generally the most adversely affected; mollusks were the most resistant. The paper also discusses the parameters and results of bioassay methodology applied to this study.

[from Chemical Abstracts 84(10)#70019. 1976.]

C-1577-76
AID FOR OILED WATERFOWL

Hay, K.G. 1975.
Atlantic Naturalist 30(4):156-163.

Biological effects, Oil spills, Birds, Contingency planning, Personnel training

Past and current studies of the effects of oil on seabirds are reviewed. Recent oil spill disasters and their effects on waterfowl are also discussed. Contingency planning and training of volunteers are felt to be essential in reducing the mortality rate of oiled birds.

C-1578-76
EFFECTS OF OIL SPILL ON SHORE VEGETATION (English summary)

Hoiland, K. 1975.
Blyttia 33(3):141-149.

Biological effects, Oil spills, Plants, Algae

Fresh crude oil spills have a more harmful effect on certain onshore plants and filamentous algae than do weathered spills. Oil emulsifiers harm some plants more than crude oil alone. Perennial plants tend to show good recoveries, whereas annuals are killed after oil pollution. Ripe seeds from annuals are not harmed by the oil and develop normally in the next growing season.

[from Biological Abstracts 61(10):#54521. 1976.]

C-1579-76
THE INFLUENCE OF CRUDE OIL AND MIXTURES OF CRUDE OIL/DISPERSANTS ON THE ONTOGENIC DEVELOPMENT OF THE BALTIC HERRING, CLUPEA HARENGUS MEMBRAS L

Linden, O. 1976.
Ambio 5(3):136-140.

Biological effects, Crude oil, Dispersants, Fishes, *Baltic herring

Three different dispersants were used in studies to measure the effects of Venezuelancrude oil and oil mixed with dispersants on the Baltic herring. These included Finasol SC, which is highly toxic, and Finasol OSR-2 and BP 1100X, which are considered "non-toxic" dispersants. Results show that the toxicity of the crude oil increased several hundred-fold if the oil spill is dispersed by Finasol OSR-2 or BP 1100X, and by an additional factor of 10 if Finasol SC is used.

C-1580-76

RELATIVE TOXICITY OF SEVEN OIL SPILL EMULSIFIERS

Maggi, P. 1974.
Environmental Protection Agency, EPA-TR-45-75, PB-237-791-T/BE. 9p.
(Translation of Revue des Travaus Institut des Peches Maritimes (France) 36(1): 121-124. 1972).

Toxicity, Oil spills, Emulsifiers, Marine organisms

The direct toxicity of seven emulsifiers on several marine animals is discussed. The emulsifiers are designated E22, E30, E41, E47, E52, and E53; the results show E47 to be the least toxic of the seven.

[from EPA Reports Bibliography Quarterly. Jan.-March 75. PB-242-075-01.]

C-1581-76

DEVELOPMENT OF ALGAE MACROPHYTES UNDER OIL POLLUTION CONDITIONS (English table of contents)

Mironov, L.G., and I.M. Tsymbal. 1975.
Biologicheskie Nauki (Moscow) 18(5):53-56.

Biological effects, Crude oil, Algae, *Macrophyte development

Crude oil pollution retarded early stages of development in the sprouting of *Polysiphonia breviarticulata*, *P. opaca* and *Dilophus fasciola*. Change of color, plasmosis and disturbed cell structure accompanied death of the sprouts.

[from Biological Abstracts 61(6):#33484. 1976.]

C-1582-76

EFFECT OF SOME LIQUID PETROCHEMICAL INDUSTRY PRODUCTS ON SOIL MICROFLORA (English summary)

Munjko, I. 1975.
Hemijska Industrija 29(6):257-263.

Biological effects, Petrochemicals, Soil, Microorganisms, Plants

The development of the petrochemical industry has caused significant pollution of the ground and groundwater. The favorable and unfavorable effects of pollutants such as styrene, tetrapropene, and ethylbenzene depend on their concentration in the ground. Addition of phenol completely destroys ground microflora and vegetation, and recovery is slow.

C-1583-76

PETROLEUM COMPONENTS AND OBJECTIONABLE MALODOROUS SUBSTANCES IN FISH FLESH POLLUTED BY BOILER FUEL OIL

Ogata, M., and T. Ogura. 1976.
Water Research 10(5):407-412.

Biological effects, Hydrocarbons, Fuel oil, Fishes, *Girella punctata, *Eels (Angulla rostrata)

Groups of eels (Angulla rostrata) and green fish (Girella punctata) were reared for up to 14 days in artificially oil-polluted test dilutions prepared by mixing heavy fuel oil and sea water. Gas chromatography was used to identify the petroleum components that had infiltrated the fish flesh. Unsaturated aliphatic hydrocarbons and some aromatic hydrocarbons were revealed as sources of the repugnant odor of the polluted fish flesh.

C-1584-76

EFFECTS OF LOW CONCENTRATIONS OF OIL ACCOMMODATED IN SEA WATER ON THE GROWTH OF UNIALGAL MARINE PHYTOPLANKTON CULTURES

Prouse, N.J., D.C. Gordon, Jr. and P.D. Keizer. 1976.
Journal of the Fisheries Research Board of Canada 33(4, part 1):810-818.

Crude oil, Fuel oil, Biological effects, Phytoplankton, Algae

The effects of three oils (Venezuelan crude, Kuwait crude, and No. 2 fuel oil) on the growth of five different marine algal species were investigated under simulated polluted sea water conditions (< 1 mg oil/liter). In most experiments minor stimulation or inhibition of growth was apparent. The study suggests that oil pollution is sea water results in relatively minor and short-lived effects on the growth of phytoplankton.

C-1585-76
DEATHTRAPS FOR BIRDS

Randall. D. 1975.
Defenders of Wildlife News 50(1):35-38.

Biological effects, Oil spills, Oil wells, Birds

This article surveys in detail the serious bird losses in the United States caused by practices such as pole trapping, pollution resulting from abandoned oil wells and oil spilled into streams, and contamination from trona refining plants.

C-1586-76
PRE-EXPOSURE INDUCED CHANGES IN THE TOXICITY OF A CRUDE AND A REFINED OIL FOR THE POLYCHAETOUS ANNELID, *NEANTHES ARENACEODENTATA*

Rossi, S.S., and J.W. Anderson. 1975.
American Zoologist 15(3):788. Abstract.

Toxicity, Crude oil, Fuel oil, Annelids, **Neanthes arenaceodentata*

Pre-exposure to sub-lethal levels of a crude or refined oil for 28 days markedly decreased the toxicity of both oils for *N. arenaceodentata*. Pre-exposure to fuel oil produced the greatest changes in sensitivity; the degree of changes was directly related to the concentration of diaromatic hydrocarbons present in the media.

C-1587-76
METABOLISM OF AROMATIC HYDROCARBONS IN COHO SALMON (*ONCORHYNCHUS KISUTCH*)

Roubal, W.T., T.K. Collier, and D.C. Malins. 1976.
Federation Proceedings 35(7):1710.

Monitoring, Aromatic hydrocarbons, Fishes, *Coho Salmon

Benzene-U-^{14}C, naphthalene-1-^{14}C, and anthracene-9-^{14}C were administered to juvenile coho salmon in the food and by intraperitoneal injection. After each exposure, ^{14}C in key organs (i.e. liver, brain) increased with time in the order anthracene>naphthalene>benzene. After intraperitoneal injection the highest percentages of aromatic metabolites occurred in the gallbladder and significant amounts were found in the liver, brain, and muscle. Data suggest that aromatic metabolites are broadly distributed in fish exposed to polynuclear aromatic hydrocarbons and consideration of these products should be included when quantifying aromatic hydrocarbons in marine fish.

C-1588-76

EFFECT OF CRUDE OIL ON ZOOBENTHOS COLONIZATION OF ARTIFICIAL SUBSTRATES IN SUBARCTIC AQUATIC ECOSYSTEMS

Rosenberg, D.M., and N.B. Snow. 1974.
Congress International Association of Limnology, 19th, Winnipeg, Canada, 1974. Verhandlungen-Internationaler Verein für Theoretische und Augewandte Limnologie 1975. Part 3. p.2172-2177.

Biological effects, Crude oil, Contamination, Invertebrates, *Oil-treated substrates

The average numbers of invertebrates colonizing oil-treated artificial substrates vs. untreated controls were compared for four subarctic rivers; the results were found to be inconsistent. Possible reasons for the different results are considered, and the use of this system for investigating contamination by crude oil is discussed.

[from Chemical Abstracts 84(21):#145526v. 1976.]

C-1589-76

EXPERIMENTAL INVESTIGATION OF THE DERMATOTROPIC EFFECT OF SOME DERIVATIVES OF CRUDE OIL. I. INVESTIGATION OF THE DERMATOTROPIC EFFECT OF MINERAL OIL EXTRACTS CONTAINING PARAFFIN AND PARAFFIN-FREE EXTRACTS (English summary)

Sak, M., E. Hegyi, and K. Miglierini. 1975.
Ceskoslovenska Dermatologie 50(3):192-196.

Biological effects, Health hazards, Crude oil, Hydrocarbons, Aromatic hydrocarbons

This article calls attention to the health hazards and economic importance of occupational skin diseases caused by crude oil products, which accounted in 1972 for 17.3% of all reported occupational skin diseases in Czechoslovakia and for 14.8% in the U.S.S.R. Using the epicutaneous tests in man and kerotose tests in rabbits, it was shown that paraffin-free refined oils, especially those with a higher content of aromatic hydrocarbons, have a more marked dermatotropic effect.

C-1590-76

EXPERIMENTAL INVESTIGATION OF THE DERMATOTROPIC EFFECT OF SOME DERIVATIVES OF CRUDE OIL. II. INVESTIGATION OF THE DERMATOTROPIC EFFECT OF FRACTIONS AFTER MOLECULAR DISTILLATION OF THE PARAFFIN-FREE EXTRACT OF OIL FROM SARATOVO CRUDE OIL (English summary)

Sak, M., E. Hegyi, and K. Miglierini. 1975.
Ceskoslovenska Dermatologie 50(3):192-196.

Biological effects, Health hazards, Crude oil, Hydrocarbons, Aromatic hydrocarbons

The title investigation was conducted using the epicutaneous test for man and the keratose test in rabbits. Samples rich in aromatic hydrocarbons were found to cause the most marked microscopic tissue changes.

C-1591-76
THE EFFECTS OF AQUEOUS EXTRACTS OF CRUDE OIL AND NAPHTHALENE ON THE PHYSIOLOGY AND MORPHOLOGY OF A FRESH WATER GREEN ALGA

Soto, C., J.A. Hellebust, and T.C. Hutchinson. 1975.
Verhandlugen Internationale-Vereingung für Theoretische Angewandte Limnologie 19(Part 3):2145-2154.

Biological effects, Crude oil,*Naphthalene, Freshwater, Algae, *Chlamydomonas angulosa

Crude oil extracts, especially naphthalene, were found to induce detrimental morphologic changes and inhibited the growth and photosynthesis of the green alga, Chlamydomonas angulosa.

[from Chemical Abstracts 84(19):#131074j. 1976.]

C-1592-76
THE TOXICITY AND PHYSIOLOGICAL EFFECTS OF OIL AND PETROLEUM HYDROCARBONS ON ESTUARINE GRASS SHRIMP PALAEMONETES PUGIO (HOLTHIUS)

Tatem, H.E. 1975.
Ph.D. Thesis, Texas A & M University. 142p.

Toxicity, Crude oil, Hydrocarbons, Crustaceans, *Naphthalenes, *Grass shrimp

The title investigations have shown that grass shrimp are susceptible in increasing degrees to the toxic effects of crude oil, refined oils and petroleum hydrocarbons, in that order. Naphthalenes were found to be expecially toxic. Petroleum and its derivative hydrocarbons were found to have adverse effects on the hatching, development, activity and behavior of shrimp.

[from Chemical Abstracts 84(17):#116574d. 1976.]

C-1593-76
WATER QUALITY OF THE CULTURE BEDS OF HARD CLAM AND ADJACENT SEA OF THE YEOSU REFINERY OF HONAM OIL REFINERY COMPANY IN KWANG YANG BAY (English summary)

Won, J.H., and N.P. Go. 1975.
Bulletin of the Korean Fish Society 8(2):73-84.

Biological effects, Oil spills, Wastewater, Refineries, Mollusks, Korea, South.

"The effects of oil spill from the wastewater of Yeosu Refinery on water quality of hard clam culture beds in Taein-Ri, Kwang Bay, South Korea, were studied. Wastewater and oil spillage may reach culture beds in 6-8 hours by tidal current movement. Water quality is nearly as normal as unpolluted seawater except the concentration of n-hexane extractive chemicals which was higher than unpolluted seawater in Sept.-Oct. 1973. It may be caused by wastewater of Yeosu Refinery."

[from Biological Abstracts 61(10):#57643. 1976.]

2. ECONOMIC EFFECTS

C-1594-76
RENOVATION TO MEET POLLUTION RULES COST TOM RABE $60,000 (news brief)

Anon. 1976.
National Petroleum News 68(3):60.

Economic effects, Regulations, Pollution prevention

Albermarle Oil Co. has spent about $60,000 remodeling an 18-year-old bulk plant in order to comply with federal spill-prevention control regulations to prevent pollution of a nearby stream. Plant changes are described.

3. GENERAL EFFECTS

C-1595-76
MARINE ENVIRONMENT

Adamo, L.C. et. al. 1975.
IES Energy and Environment Conference, Anaheim, 1975. Vol.
p.49-76.

Oil transport, Oil slicks, Environmental effects, Oil spills, California, New York

Papers on the following topics were presented: seasonal mean transport of hypothetical oil spills occurring in nearshore waters of Long Island, N.Y.; study of a water quality imager for coastal zone missions; the Lockheed offshore oil recovery system; and the effects of discharge design on the thermal mixing zone in waterways.

[from Environment Abstracts 6(4):#76-02784. 1976.]

C-1596-76
ENVIRONMENTAL IMPACT OF EXPERIMENTAL OIL SPILLS IN THE CANADIAN ARCTIC

Adams, W.A., B.F. Scott, and N.B. Snow. 1975
American Society for Testing and Materials, Special Technical Publication No. 573 p.489-513.

Environmental effects, Oil spills, Lakes, Canada, Arctic, Biological effects

Two crude oils were spilled into separate, typically productive Mackenzie River Delta lakes which had been partitioned to provide a spill area and a control area. Various physical, chemical, and biological parameters were measured before and after spillage and were monitored over a period of time. Among the many effects observed were the initial heavy mortality of littoral invertebrates and microorganisms, followed by eutrophication conditions, and a decrease in diversity of flora and fauna.

C-1597-76
PROCEEDINGS OF THE NINTH WORLD PETROLEUM CONGRESS. VOLUME 6, CONSERVATION AND SAFETY

Anon. 1975.
Barking, Essex, England, Applied Science Publishers, Ltd., 1975.
338p.

Environmental protection, Petroleum industry, Oil spills

Held in Tokyo, Japan, in May 1975, this conference covered topics such as sulfur removal, microbiological petroleum processing, environmental protection in industry, and oil spills on land and in water.

[from Environmental Science and Technology 10(5):499. 1976.]

C-1598-76
TROPICAL MARINE POLLUTION

Ferguson Wood, E.J., and R.E. Johannes. 1975.
Oxford, Elsevier, 1975. 192p. (Elsevier Oceanographic Series 12)

Environmental effects, Biological effects, Coral reefs, *Mangroves, *Sea grass ecosystems

This book is a synthesis of what is presently known about the effects of various kinds of pollution on the tropical to subtropical marine and nearshore environment. Included are discussions of the effects of oil pollution on coral reef communities, mangroves, and tropical sea grass ecosystems.

C-1599-76
OIL POLLUTION OF INLAND WATERS

Fielding, M. 1976.
Public Health Engineer 4(1):18-22.

Freshwater, Groundwater, Oil spills, Environmental effects

The acute and chronic effects of oil pollution of groundwater and inland surface waters are reviewed. Environmental effects of oil pollution are extremely variable and problematic because of the wide ranges in toxicity, volatility, solubility and degradability of the many hydrocarbon components of crude oil and refined petroleum. Current problems in sampling, detecting and monitoring of oil contaminants are discussed.

C-1600-76
CHEMICAL CYCLES AND THE GLOBAL ENVIRONMENT. ASSESSING HUMAN INFLUENCES

Garrels, R.M., F.T. MacKenzie and C. Hunt. 1975.
Los Altos, Calif., William Kaufman, Inc., 1975. 214p.

Environmental effects, oil spills

Included in this review of man's influence on the exogenic cycle are sections dealing with petroleum and its pollution of atmosphere and oceans,

[from Biological Abstracts 61(5):#24836. 1976.]

C-1601-76
IMPACT OF OIL OPERATIONS ON THE MARINE ENVIRONMENT

Halladay, W.B., and E.W. Mertens. 1975.
Petroleum and Environmental Conservation. International Petroleum Industry Environmental Conservation Association, 1975. p.155-181.

Environmental effects, Oil spills, Pollution prevention, Offshore production, Tankers, Liability

Many aspects of the fate and effects of oil spills and oil pollution in the marine environment are reviewed. Other topics discussed are oil spill prevention, cleanup, and control in offshore platforms, tankers and terminals; various pollution liability agreements; and analysis and measurement of oil pollutants.

[from Pollution Abstracts 7(2):#76-01302. 1976.]

C-1602-76
THE CHEMISTRY AND MICROBIOLOGY OF POLLUTION

Higgins, I.J., and R.G. Burns. 1975.
New York, Academic Press, 1975. 248p.

Environmental effects, Hydrocarbons, Manuals

This interdisciplinary work is aimed at students and workers in the environmental sciences. The contents include pesticides, sewage and fertilizers, hydrocarbons, surfactants, synthetic polymers, metals, and miscellaneous pollutants.

[from New Technical Books 61(4):434. 1976.]

C-1603-76
RESEARCH PROGRAMS FOR INVESTIGATIONS OF THE BALTIC AS A NATURAL RESOURCE WITH SPECIAL REFERENCE TO POLLUTION PROBLEMS

International Council for Exploration of the Sea. 1974.
International Council for Exploration of the Sea, Research Report No. 42. p.1-45.

Baltic Sea, Resource management

Summary not available.

[from Bioresearch Index 11(6):#46484. 1975.]

C-1604-76
SEDIMENTS AND SEDIMENTARY PROCESSES, YUKON BEAUFORT SEA COAST

Lewis, C.P. 1975.
Geological Survey of Canada, Paper75-1, Part B. p.165-170.

Biological effects, Physical effects, Oil spills, Coasts, Beaufort Sea, *Geologic studies

The report outlines the scope of geological field work which was conducted along the Yukon-Beaufort Sea coast in 1974 to determine its susceptibility to oil spills. This work was part of a study to assess the frequency and duration of inundation of coastal features by oily sea water, and to evaluate the possible biological and physical effects of oil spillage on the coastal zone.

C-1605-76
POLLUTION OF SEA BOTTOM DEPOSIT (English summary)

Murakami, A. 1975.
Umi to Sora 50(2-3):27-39.

Crude oil, Environmental effects, Sediments, Japan

"Organic pollution of the sea bottom deposit, such as COD, IL, total S, oil, N, P, and heavy metals, and its effects are discussed. Conditions in the Seto Inland Sea are related. Recovery of such polluting sea bottom deposits is examined."

[from Pollution Abstracts 7(2):#76-01486. 1976.]

C-1606-76
ASSESSING POTENTIAL OCEAN POLLUTANTS

National Academy of Sciences. 1975.
Washington, D.C., Printing and Publishing Office, National Academy of Sciences, 1975. xx + 438p.

Toxicity, Hydrocarbons, Aromatic hydrocarbons, Biological effects, Bibliographies

This publication summarizes five aspects of pollutants in the marine environment: their rates of production and release into the environment: their persistence, concentrations and toxicity; and their ultimate environmental fate. Presented is a comprehensive review of aromatic hydrocarbons, with emphasis on the petroleum derivatives benzene and toluene and their bioaccumulation and biological effects. An extended bibliography on hydrocarbons is included.

C-1607-76
ENVIRONMENTAL ASSESSMENT OF THE ALASKAN CONTINENTAL SHELF. VOLUME 4. EFFECTS OF CONTAMINANTS

National Oceanic and Atmospheric Administration. 1975.
Program Work Statements, NOAA-75112904. 72p.

Environmental effects, Contaminants, Hydrocarbons, Crude oil, Alaska coast

The report consists of nine papers which concern the effects of contaminants (oil, hydrocarbons, petroleum, etc.) on the Alaskan coastal waters. "Portions of this document are not fully legible."

[from Government Reports Announcements 76(7):#PB-248 935/9GA. 1976.]

C-1608-76
PERSISTENT ORGANIC RESIDUES

Portmann, J.E. 1974.
International Symposium on Discharge of Sewage from Sea Outfalls, London, England, 1974. A.L.H. Gameson (ed.). Oxford, England, Pergamon Press, 1975. p.123-130.

Environmental effects, Biological effects, Petrochemicals, Wastewater disposal

The article reviews the occurrence of organic chemicals, including petrochemicals, in wastewaters and discusses the effects of their accumulation and concentration in natural waters and organisms.

[from Chemical Abstracts 84(18):#126299g. 1976.]

C-1609-76
CHEMICALS HARMFUL TO WATER (English summary)

Schefer, W. 1975.
Forum der Unwelthygiene 1(1):13-17.

Fuel oil, Contamination, Environmental effects, Decomposition, Toxicity

The increasing contamination of natural waters by various manufactured chemical substances including fuel oil is discussed. These chemicals should be tested for their potential adverse environmental effects prior to their discharge. Preliminary tests are recommended that will characterize these substances as to their degradability and toxicity.

[from Water Research Center Information 3(3):#76-1955. 1975.]

C-1610-76
RECENT AIR AND WATER POLLUTION CONTROL IN PETROLEUM REFINERIES

Takabayashi, M. 1975.
Yukagaku 24(11):812-817.

Refineries, Pollution prevention

The article discusses the kinds of air and water pollution arising from the combustion of petroleum products and from petroleum refinery processes.

[from Chemical Abstracts 84(12):#78970. 1976.]

C-1611-76
EFFECTS OF PETROLEUM POLLUTION ON THE DISTRIBUTION OF HYDROCARBONS IN MARINE MUDS (English summary)

Tissier, M.J., and J.L. Oudin. 1974.
Advances in Organic Geochemistry 1973. B. Tissot, and F. Bienner (eds.). Paris, France, Editions Technip, 1974. p.1029-1041.

Sediments, Chemical analysis, Hydrocarbons, Coasts, France

The hydrocarbon content of mud samples from the northwest coast of France was analyzed qualitatively and quantitatively in order to determine the amounts and types of hydrocarbons present and to distinguish the naturally occurring hydrocarbons from those derived from pollutant sources. Marine muds were found to be less contaminated with pollutant hydrocarbons than coastal muds; the latter showed a weak enrichment of heavy aliphatic hydrocarbons.

D. EFFECTS OF OIL EXPLORATION AND PRODUCTION

1. BIOLOGICAL EFFECTS

C-1612-76
A BIOLOGICAL SURVEY OF OIL PLATFORMS IN THE SANTA BARBARA CHANNEL

Bascom, W., and M. Moore. 1976.
Offshore Technology Conference, 8th, Houston, 1976. Paper no. OTC-2523. Abstract.

Offshore drilling, Offshore production, Biological effects, Marine organisms, Santa Barbara Channel

The findings of a study conducted in 1975 to assess the initial and long term effects of drilling/production operations on marine life are presented. The study indicates that abundant species of fish, mollusks, and other marine organisms live on and near the structures with no indication of any toxicant uptake.

C-1613-76
OIL SHALE AND WILDLIFE: WHAT'S IT ALL ABOUT

Blum J.R. 1975.
Colorado School of Mines Quarterly 70(4):147-152.

Oil shale development, Biological effects, Wildlife

The development of oil shale resources will have a damaging impact on fish, wildlife and their habitats, the severity of which cannot be adequately determined at present. Certain aspects of strip mining, in-situ processing, transportation, disposal and related activities may severely contaminate or destroy these natural areas.

[from Petroleum Abstracts 16(16):#218,649. 1976.]

C-1614-76
OFFSHORE ECOLOGY INVESTIGATION; EVOLUTION OF OIL INDUSTRY IMPACT ON CENTRAL COASTAL LOUISIANA

Morgan, J.P. 1975.
American Association of Petroleum Geologists, Bulletin 59(9):1728. Abstract.

Offshore development, Louisiana, Biological effects, Marine organisms, Fisheries

A multidisciplinary cooperative study of the environmental impact of three decades of intensive offshore development and production has been completed for the Timbalier Bay, Louisiana region. Comparison of the new data with baseline data of 1952 reveals no significant detrimental effects on marine organisms, commercial fish, and shrimp and oyster production. Instead, these studies indicated that oil production areas have become biologically more productive and contain a larger biomass than in the period prior to offshore activities.

2. SOCIAL EFFECTS

C-1615-76
THE TRADEOFF BETWEEN ENERGY AND THE ENVIRONMENT: THE CASE OF CRUDE OIL SUPPLIES FOR CALIFORNIA

Barnett, D.W. 1975.
Ph.D. Thesis, Pennsylvania State University, 310p.

Models, Socio-economic effects, Environmental effects, Offshore production, Oil spills

An analytical model is developed which ranks the comparative social, economic, and environmental costs and benefits of various petroleum sources that do or could supply the California market. The study, which includes oil spill risk analyses, suggests that certain domestic offshore oil resources can be environmentally and economically superior to foreign oil.

[from Scientific and Technical Aerospace Reports 14(8):#N76-16508. 1976.]

C-1616-76
THE DURHAM CONTROVERSY: ENERGY FACILITY SITING AND THE LAND USE PLANNING AND CONTROL PROCESS

Deal, D.T. 1975.
Natural Resources Lawyer 8(3):437-453.

Refineries, New Hampshire, Socio-economic effects

The controversy arising over the 1973 proposal by Olympic Refining Co., a Greek corporation, to construct an oil refinery in Durham, New Hampshire, and an offshore terminal in the Isles of Shoals is reviewed.

[from Environment Abstracts 6(4):#76-02712. 1976.]

C-1617-76
POLLUTION

Mancke, R.B. 1974.
The Failure of U.S. Energy Policy. New York, Columbia University Press, 1974. p.35-46.

*U.S. energy production, Legislation, Social effects

Pollution by oil and other substances; is seen to be the costly byproduct of socially desirable and necessary activies such as energy production. The chapter outlines the increasing awareness of American society since the mid-1950's toward pollution problems and identifies the several legislative options available to government policy makers in controlling polluting industries.

3. ECONOMIC EFFECTS

C-1618-76
THE ECONOMIC IMPACT OF ENVIRONMENTAL REGULATIONS

Anon. 1974.
U.S. Congress, 93rd, 2nd Session, Senate. Joint Economic Committee, Senate Concurrent Resolution 93, Nov. 19, 21-22, 1974. Hearings. GPO-51-795. 230p.

Economic effects, Regulations, Pollution prevention, Offshore development, Legislation

The economic effects of energy conservation and environmental regulations are discussed. The impact of pollution control legislation on the development of energy resources, including offshore oil, and the interactions between environmental regulations and the economy are among the topics considered.

4. GENERAL EFFECTS

C-1619-76
No title given (news brief)

Anon. 1976.
Chemical Engineering 83(4):46.

Oil-gas leasing, Atlantic coast, EIS

A favorable attitude toward Atlantic offshore-oil production emerged during the public hearings on the environmental impact of leasing oil and gas tracts off the mid-Atlantic coast, held January, 1976, in Atlantic City. The Department of the Interior will prepare a final environmental impact statement which will be followed by its review by the Council on Environmental Quality and a final decision on the leasing program by Secretary of the Interior Thomas Kleppe.

C-1620-76
12.8 MILLION ACRES NOMINATED OFF ALASKA (news brief)

Anon. 1976.
Ocean Industry 11(3):73.

Oil-gas leasing, Environmental effects, Offshore exploration, Alaska, Gulf of

Thirteen oil companies have expressed interest in 2,326 tracts in the western Gulf of Alaska, comprising nearly 5.2 million hectares. Fisheries groups and the U.S. Fish and Wildlife Service have expressed concern over the environmental effects of oil exploration, especially on the Kodiak Island environment and on fishing grounds along its southern and eastern shores.

C-1621-76
AN ANALYSIS OF THE FEASIBILITY OF SEPARATING EXPLORATION FROM PRODUCTION OF OIL AND GAS ON THE OUTER CONTINENTAL SHELF

Anon. 1975.
Office of Technology Assessment, Washington, D.C. 300p.

Offshore exploration, Offshore production, Environmental effects, OCS

The report contains the results of an analysis of the feasibility of separating offshore exploration from offshore production and an analysis of the consequences, including environmental impacts, likely to occur from this separation.

[from Government Reports Announcement 76(7):#PB-248 381/6GA. 1976.]

C-1622-76
BERING SEA TRACTS DUE TOUGH ENVIRONMENTAL STUDY

Anon. 1976.
Oil and Gas Journal 74(12):46.

Oil-gas leasing, Bering Sea, Environmental effects, Offshore exploration

An original federal lease sale list of 3600 tracts totalling over 8.3 million hectares has been sharply reduced to 299 tracts totalling 0.65 million hectares. This reduced list of tracts will undergo an unusually intense environmental impact study because the area includes migratory routes and breeding and feeding grounds for many species of mammals, fishes and birds. In addition, the area already supports major international fisheries.

C-1623-76
COOK INLET TRACTS CHOSEN FOR FUTURE SALE OFFERINGS

Anon. 1976.
Offshore 36(5):232.

Oil-gas leasing, Alaska, Gulf of, EIS, *Cook Inlet

152 connected OCS tracts occupying over 344,000 hec. in Alaska's Cook Inlet have been tentatively selected by the U.S. Bureau of Land Management for oil-gas leasing. This action is pending the outcome of a primary environmental impact statement, public hearing, and a final environmental impact statement.

C-1624-76
ENVIRONMENTAL STATEMENTS FOR OFFSHORE OPERATIONS

Anon. 1975.
Sea Technology 16(4):25-26, 29-30.

EIS, Offshore drilling, Oil-gas leasing

Comprehensive environmental statements will be required for all offshore drilling operations to be conducted in 24 proposed lease areas offered by the U.S. Bureau of Land Management. This requirement and other factors, such as state legislation and pressure from environmental groups will affect the oil industry's decision to lease offshore land.

[from Petroleum Abstracts 16(11):#217,418. 1976.]

C-1625-76
MARITIME ADMINISTRATION TITLE XI. VESSELS ENGAGED IN OFFSHORE OIL AND GAS DRILLING OPERATIONS

Anon. 1976.
Final Environmental Impact Statement, MA-EIS-7302-76015F. 370p.

EIS, Offshore drilling, Environmental effects

Floating offshore oil and gas drilling units and their support vessels constructed under Title II of the Merchant Marine Act, 1936, are described in this report. Information on the marine environment, the possible environmental impact of these vessels, and alternatives to Title II financing of such vessels is presented.

[from Government Reports Announcements 76(7):#PB-248 857/5GA. 1976.]

C-1626-76
OFFSHORE DRILLING SOUGHT AS PRELUDE TO OSC [sic] SALE (news brief)

Anon. 1976.
Offshore 36(5):271.

Offshore drilling, Alaska, Gulf of, Oil-gas leasing, Environmental effects

Offshore exploratory drilling in Alaska's Cook Inlet is proposed prior to bidding in the upcoming OCS oil-gas leasing sale. Several U.S. agencies are urging the exclusion of about 121,000 hectares from a possible 810,000 hectares because of the possible dangers to fishing and marine mammals. Alaska's Department of Environmental Conservation is concerned about the possible effects of earthquakes on oil exploration and resultant pollution dangers to wildlife.

C-1627-76
OFFSHORE OIL (news brief)

Anon. 1976.
Alaska Seas and Coasts 4(1):5.

Oil-gas leasing, Alaska, OCS

This news item describes the continued delays of the Interior Department's scheduled oil and gas lease sales on the outer continental shelf of Alaska. Various environmental, conservation and fisheries groups are asking that the sales be restricted in certain areas or delayed until better techniques for oil spill cleanup in rough waters are developed.

C-1628-76
OIL ÜBER ALLES (news brief)

Anon. 1976.
Environmental Action 7(23):11.

Refineries, Environmental effects, Fisheries, Virginia

Environmental concern is increasing over the proposed Portsmouth oil refinery to be constructed at the junction of Virginia's Elizabeth River and the Chesapeake Bay. Environmentalists are arguing that the 175,000-barrel-per-day complex threatens the productivity of the estuary, would disrupt the local tourist and fishing industries, and would be a prime source of air pollution. Supporters claim that it would further the country's goal of energy independence, and tax revenues to Portmouth would ease the city's financial problems.

C-1629-76
OPERATORS GIVE THEIR SIDE OF OIL/FISH HASSLE

Anon. 1976.
National Fisherman 56(10):8B-9B.

Offshore development, North Sea, Fisheries, Economic effects

Several questions concerning the development of North Sea oil are answered by an oilman. Emphasis is put on the oil industries' efforts to cooperate with the fishing industry in matters concerning geographical water rights, pipeline damage and pollution.

C-1630-76
SALE OF BERING SEA TRACTS IS SHARPLY REDUCED BY INTERIOR (news brief)

Anon. 1976.
Offshore 36(5):307.

Oil-gas leasing, Alaska, Bering Sea, Environmental protection

The U.S. Department of Interior has sharply reduced the acreage of a proposed oil-gas lease sale for the southeastern Bering Sea off Alaska from 617 million hectares to 0.6 million hectares. Much of this acreage has been withdrawn because it contains environmentally critical areas, such as the St. George Basin region, which is believed to be among the biologically most productive waters in the world; or it encompasses animal migratory routes, breeding grounds, and native subsistence fishery areas.

C-1631-76
SOCAL SEEKS PERMIT FOR NEW DRILLING IN SANTA BARBARA CHANNEL

Anon. 1976.
Offshore 36(5):318.

Santa Barbara Channel, Offshore drilling, EIS, Oil spills

Standard Oil of California wants to drill 36 new wells from its four existing platforms in the Santa Barbara Channel. According to its draft environmental impact statement prepared for California's State Lands Commission, Standard believes it could triple offshore production without greatly increasing the risk of an oil spill, and without incurring irreversible environmental changes.

C-1632-76
SOVIETS ADMIT TROUBLES IN OIL SHALE

Anon. 1975.
Oil and Gas Journal 73(40): 42-43.

Oil shale development, USSR, Environmental effects, Production

The Russian oil shale industry in the Estonian basin is experiencing some serious problems, including large-scale mining losses, a continuing lag in production of oil shale-derived fuels and chemicals, and unacceptably high environmental pollution problems.

[from Fuel Abstracts 17(3):1526. 1976.]

C-1633-76
TRACTS PICKED OFF PRIBILOF ISLANDS

Anon. 1976.
Offshore 36(5):216.

Oil-gas leasing, OCS, Bering Sea, Environmental protection

Comprehensive environmental studies are set to begin on a 0.7 million hectare proposed OCS lease area southeast of the Pribilof Islands in the Bering Sea. The present site was selected by various concerned federal agencies from an original area totalling 6.7 million hectares Tracts that were eliminated included areas of nutrient upwelling, migratory routes, and breeding and feeding grounds for many fish, mammal and bird populations.

C-1634-76
WHERE THE SEA MEETS LAND: THE COASTAL ZONE

Anon. 1976.
Environmental Science and Technology 10(2):118-119.

Coasts, Legislation, Offshore development, Environmental management

The objective of the newly formed Coastal Society is to gather the necessary information to provide an holistic approach to coastal science management, planning and assessment. The Society held a conference on "The Present and Future of Coasts" in November, 1975, and covered topics relating to the present status of coasts, coastal legislation, U.S. offshore oil policies and coastal environmental impacts, and food and energy as resources or threats.

C-1635-76
ALBERTA'S ATHABASCA OIL SANDS: A CANADIAN PERSPECTIVE

Bresee, P., and S. Tyler. 1975.
Alternatives 4(2):21-33.

Environmental effects, Production, Tar sands, Canada, *Alberta

The article discusses various aspects of the development of Alberta's Athabasca oil sands including possible environmental effects. The strip-mining operations as well as the disposal of tailings and tarry residues will have widespread adverse effects on the land, wildlife, vegetation and groundwater. Large in-situ processing plants, refineries, and petrochemical plants will present a host of environmental problems, including thermal and oil pollution and disposal of liquid and gaseous wastes.

C-1636-76
INPUT OF LOW-MOLECULAR-WEIGHT HYDROCARBONS FROM PETROLEUM OPERATIONS INTO THE GULF OF MEXICO

Brooks, J.M., J.R. Gormly, and W.M. Sackett. 1975.
EOS 56(6):373. Abstract.

Offshore production, Gulf of Mexico, Monitoring, Hydrocarbons

Monitoring studies of dissolved C_1 to C_4 hydrocarbons in shelf waters of the Gulf of Mexico have revealed an increase of two orders of magnitude over the last five years. The sources of these hydrocarbons are waste brines and gases discharged from offshore platforms.

C-1637-76
EXPERIMENTAL DESIGN FOR AN ENVIRONMENTAL PROGRAM: HYDROCARBON ANALYSIS IN AN OIL PRODUCING AREA

Darker, P.L. 1974.
Marine Environmental Implications of Offshore Drilling in the Eastern Gulf of Mexico. R.E. Smith (ed.). St. Petersburg, Florida, State University System of Florida, Institute of Oceanography, 1974. p.279-289. Proceedings.

Hydrocarbons, Offshore production, Louisiana, Oil spills, Biological effects, Analytical techniques

The chronic level of individual hydrocarbon types was 1-10 ppb for offshore Louisiana. In areas of oil spills, hydrocarbons may reach levels at which photosynthetic microorganisms and animal eggs are adversely affected. Present analytical techniques are adequate acquire baseline chemical data and to detect adverse effects of aromatic hydrocarbons at environmentally realistic levels.

C-1638-76
ENVIRONMENTAL AND ECONOMIC IMPACT OF OFFSHORE PETROLEUM

Devanney, J.W. 1974.
Zeitschrift der Technischen Universität Berlin 6(3):348-366.

Offshore development, Environmental effects, Economic effects, Atlantic coast, Alaska, Gulf of

Two major studies of the environmental and economic impact of offshore petroleum development are reviewed and the most important results are summarized. The areas studied are the Georges Bank and New England, and the Atlantic and Gulf of Alaska continental shelves.

[from Environmental Health and Pollution Control 8(10):#2992. 1975.]

C-1639-76
ENVIRONMENTAL PROTECTION IN OFFSHORE AND PRODUCTION OPERATIONS

Falkingham, D.H. 1975.
Petroleum and Environmental Conservation. International Petroleum
Industry Environmental Conservation Association, 1975. p.215-240.

Environmental protection, Offshore exploration, Offshore production, Oil transport, North Sea

Environmental protection and safety measures used in offshore exploration, production, and oil loading and transfer facilities are reviewed. Methods to deal with oil spills are described. The oil industry's cooperative environmental efforts are illustrated with examples from North Sea operations.

[from Pollution Abstracts 7(2):#76-01930. 1976.]

C-1640-76
FLORIDA COASTAL POLICY STUDY: IMPACT OF OFFSHORE OIL DEVELOPMENT

Florida State University, Department of Urban and Regional Planning;
University of South Florida, Department of Geography 1975.
Talahassee,Florida, Florida Energy Office, 1975. 273p.

Offshore development, Florida coast, Environmental effects, Regulations

This report discusses the following areas related to offshore oil and gas development: associated facilities, socio-economic impacts, environmental impacts, pipeline monitoring, deepwater port development in Florida, and projected offshore oil and gas reserves. The study was initiated to help minimize any adverse effects on coastal areas through the identification of guidelines and regulations which should be implemented for onshore development.

[from The Marine Newsletter 7(2):3. 1976.]

C-1641-76
ONSHORE IMPACT OF OFFSHORE DEVELOPMENT NEEDS TO BE HANDLED WITH CARE AND PLANNING

Frausseu, H.T. 1976.
Offshore 36(5):352-376.

Offshore development, Biological effects, Socio-economic effects, Environmental management

This article is a broad review of the biological, socio-economic, and offshore and onshore environmental effects of oil production. The varied sources of oil spills and oil pollution in marine environments are reviewed, and the necessity of careful local and regional environmental planning in offshore development is stressed.

C-1642-76
OFFSHORE PETROLEUM DRILLING AND PRODUCTION

Hickman, R.R. 1975.
Report of the Conference on Marine Resources of the Coastal Plains States, Savannah, Georgia, 1975. Wilmington, North Carolina, Coastal Plains Center for Marine Development Service, 1975. p.81-84.

Offshore drilling, Offshore production, Gulf of Mexico, Design and engineering, Pollution prevention

The paper outlines the scope and diversity of present offshore exploration and production, and focuses on the Gulf of Mexico region. Included is a review of platform equipment designed to prevent oil spillage and leakage, and oil industry cooperative equipment for combatting major oil spills or pollution problems.

C-1643-76
AN ENVIRONMENTAL RESEARCH PROGRAM FOR DRILLING IN THE CANADIAN BEAUFORT SEA

Hnatiuk, J. 1976.
Journal of Canadian Petroleum Technology 15(1):29-36.

Environmental protection, Offshore drilling, Biological effects, Oil spills, Beaufort Sea, Canada

A comprehensive environmental research program has been developed for the southern Beaufort Sea in order to provide ecological baseline data and to help develop constraints for protecting the environment during offshore oil exploration and production activities. Specific oil-related studies in this cooperative government-industry sponsored research program include biological effects of oil spills and oil discharges and cleanup operations in ice-infested waters.

C-1644-76
OFFSHORE OIL AND GAS EXPLORATION IN LABRADOR-NEWFOUNDLAND

Howe, E.L. 1975.
Brock University, St. Catharines, Ontario, Department of Geological Sciences, Research Report Series No. 20. p.29-38.

Offshore exploration, Pollution prevention, Canada, *Labrador

This paper reviews some of the environmental factors associated with oil exploration activities off the coast of Labrador. The greatest problem in this region is the hazard of small to large icebergs which can disrupt or threaten drilling operations. The comprehensive oil pollution prevention and control measures that are employed in the drilling operations are outlined and discussed.

C-1645-76
CHARACTERISTICS AND POSSIBLE ROLE OF VARIOUS WATERS SIGNIFICANT TO IN SITU OIL SHALE PROCESSING

Jackson, L.P., R.E. Poulson, T.J. Spedding, T.E. Phillips, and H.B. Jenson. 1975.
Colorado School of Mines Quarterly 70(4):105-134.

Oil shale development, Environmental effects, Wastewater disposal

In situ oil shale development requires an assessment of the environmentally acceptable uses, storage and ultimate disposal of water produced during retorting of oil shales, as this water may contain environmentally significant amounts or organic and inorganic contaminants.

[from Petroleum Abstracts 16(16):218,670. 1976.]

C-1646-76
OFFSHORE DRILLING AND PRODUCTION ENVIRONMENTAL PROTECTION

Joens, A. 1975.
Florida Scientist 37(Supplement 1):16. Abstract.

Offshore drilling, Offshore development, OCS, Regulations, Environmental protection

This paper summarizes the latest environmental technology that is now being employed in all phases of offshore exploratory drilling, development and production operations. These technological developments are meeting stringent OCS environmental regulations and standards.

C-1647-76
THE OCS FORGOTTEN LAND: TERRITORIAL SEA, NEARSHORE, AND ESTUARY

Jones, J.I. 1975.
Report of the Conference on Marine Resources of the Coastal Plains States, Savannah, Georgia, 1975. Wilmington, North Carolina, Coastal Plains Center for Marine Development Services, 1975. p.73-75.

OCS, Offshore development, EIS, Environmental effects, Coasts, Estuaries

The area extending from the coastal region of each state offshore to three miles is the most naturally productive and environmentally vulnerable area of the continental shelf. However, this area is essentially ignored by Federal environmental studies. This article calls for increased responsibility by the Federal government and for comprehensive environmental evaluation and analysis by naturally contiguous groups of states. Studies should include environmental, social and economic impact of OCS development on coastal, littoral and estuarine regions.

C-1648-76
OUR ISLANDS OIL

Lovegrove, M. 1976.
London, England, Witherby and Co., Ltd., 1976. 167p.

North Sea, Offshore development, Environmental effects

This reference source includes topics on North Sea oil development, finance, personnel, politics, environment and conservation.

[from Oil and Gas Journal 74(12):106. 1976.]

C-1649-76
GEOLOGY OF SANTA BARBARA OIL SPILL; BEFORE AND AFTER

McColloh, T.H. 1975.
American Association of Petroleum Geologists, Bulletin 59 (11, Part I): 2196-2197. Abstract.

Offshore development, Santa Barbara Channel, Natural seepage, Oil spills

Since the 1969 blowout, 138 new wells have been drilled, and as of January, 1975, nearly 106 million barrels of oil have been produced without a single reported serious spill in the Santa Barbara Channel. Oil and gas seepage near the blowout site has steadily decreased with continued production, but large amounts of crude oil and natural gas are still released by numerous natural seeps in the channel.

C-1650-76
THE PETROLEUM INDUSTRY IN JAPAN

Miyamori, K. 1975.
World Petroleum Congress, 9th, Tokyo, 1975. Review paper 1a.

Environmental effects, Production, Petroleum industry, Japan

The paper reviews some of the current problems of the Japanese petroleum industry, among which are the problems related to environmental pollution.

[from Fuel Abstracts 17(3):#2067. 1976.]

C-1651-76
WHAT WILL BE DONE WHEN THE WELLS GO WILD

Phillips, M. 1974.
Construction News 5396:19-21.

Offshore production, Leakage, Blowout prevention, Oil wells

This article considers how serious the pollution resulting from offshore oil leakage or blowouts would be, and how the oil companies are planning to prevent such incidents and control them.

[from Ecological Abstracts 1975/6:#75L/3950. 1976.]

C-1652-76
A WESTERN REGIONAL ENERGY DEVELOPMENT STUDY: PRIMARY ENVIRONMENTAL IMPACTS. VOLUME 1

Radian Corporation. 1975.
Staff Report, EQ-4AC037-Vol-1; PB-246 264/6GA. 193p.

EIS, Oil shale development, Tar sands, Environmental effects, Production, *Western U.S.

The environmental impacts of the development of oil, oil shale, tar sands, and other resources are analyzed for Arizona, Colorado, Montana, New Mexico, North Dakota, Utah, and Wyoming. The environmental effects of all aspects of development-extraction, conversion and transportation are considered.

[from Petroleum Abstracts 16(19):#219,364. 1976.]

C-1653-76
A WESTERN REGIONAL ENERGY DEVELOPMENT STUDY: PRIMARY ENVIRONMENTAL IMPACTS. VOLUME 2

Radian Corporation. 1975.
Staff Report, EQ-4AC037-Vol-2; PB-246 265/3GA. 771p.

EIS, Oil shale development, Tar sands, Environmental effects, Production, *Western U.S.

The primary environmental impacts of 38 resource development scenarios including oil, tar sands and oil shale projects in seven western states are assessed. The production of wastewater and solid wastes during extraction, processing and transport are included in considerations of environmental effects.

[from Petroleum Abstracts 16(19):#219,363. 1976.]

C-1654-76
THE GULF OF ALASKA LURES EXPLORERS WITH PRIME STRUCTURES

Rintoul, W. 1976.
Offshore 36(5):240,243,245-247.

Alaska, Gulf of, Oil-gas leasing, Offshore development, Environmental effects, Socio-economic effects

The Gulf of Alaska oil lease sale was held in April, 1976, overriding the Environmental Protection Agency's and Council on Environmental Quality's request for a sale delay until further environmental studies are conducted. The State of Alaska and several villages also asked for delays until the onshore socio-economic impacts of offshore development are known. A significant part of the acreage was withdrawn from sale because of the high risks of oil spill damage to the Kayak Island region and to fishing areas.

C-1655-76
THE OIL SHALE ENVIRONMENTAL ADVISORY PANEL, THE ENVIRONMENT, AND THE FEDERAL PROGRAM -PAST, PRESENT, AND FUTURE

Rogers, W.L. 1975.
Colorado School of Mines Quarterly 70(4):1-18.

Oil shale development, Law enforcement, Regulations, Environmental protection

The objective of the Oil Shale Environmental Advisory Panel is to advise federal agency officials on matters dealing with enforcement of environmental regulations governing oil shale leases. Areas of concern include waste disposal, water pollution and contamination, and preservation of wildlife and vegetation.

[from Petroleum Abstracts 16(16):#218,658. 1976.]

C-1656-76
FISHERMEN'S FRIEND SET TO BATTLE AS OILMEN MOVE TO GEORGES BANK

Saft, S. 1976.
National Fisherman 57(1):16A,32A.

Offshore exploration, Georges Bank, Economic effects, Fishes, Oil spills

Many of the 206 separate Georges Bank's sites listed by the Department of Interior as possible oil exploration lease tracts will be disputed by various fishing interests and coastal resources management groups. These groups want certain tracts withheld from oil exploration because they are considered very high to high catch areas or specific spawning grounds for fish species. In addition, other interest groups want oil rigs excluded from within the 50-mile limit to prevent coastal oil pollution in case of spills.

C-1657-76
A WELL DRILLED IN VENEZUELA, DEEPEST IN LATIN AMERICA

Sensano, J., and R. Leonard. 1976.
Petroleo Internacional 34(2):14-15.

Drilling, Oil wells, Pollution prevention, Venezuela

A 5800 meter well was drilled in Lake Maracaibo in 1974. An advanced and effective surface system was used for handling the mud, especially the drill cuttings, so that no pollution of the lake's water occurred and oil spillage was avoided.

[from Petroleum Abstracts 16(12):#217,558. 1976.]

C-1658-76
QUANTITATIVE BASELINE DEFINITION FOR TERRESTRIAL ECOSYSTEMS AT OIL SHALE TRACTS C-a

States, J.B. 1975.
Colorado School of Mines Quarterly 70(4):135-141.

Monitoring, Oil shale development, Environmental effects

As part of the oil shale lease stipulations, the terrestrial baseline definition program will rigorously inventory and quantify the major components and interactions of ecosystems in and near oil shale tract C-a. This data will be used to evaluate and monitor possible environmental effects of the Rio Blanco oil shale development.

[from Petroleum Abstracts 16(16):#218,647. 1976.]

C-1659-76
PROPOSED 1976 OUTER CONTINENTAL SHELF OIL AND GAS LEASE SALE OFFSHORE THE MID-ATLANTIC STATES. OCS SALE NO. 40

U.S. Bureau of Land Management. 1976.
Washington, D.C., U.S. Government Printing Office. 1976. Vol.1-4.

EIS, Offshore development, OCS, New Jersey, Delaware, Environmental effects, Oil-gas leasing

This four-volume final environmental impact statement covers 154 tracts, of 354,820 hectares of federal OCS lands offshore the mid-Atlantic states of New Jersey and Delaware. The tracts are located 75 to 150 kilometers from shore in water depths of about 40-185 meters. Adverse environmental and socio-economic effects of OCS development are assessed. The probability of oil spillage and resultant damage to marine biota and wildlife is considered. Mitigating effects and circumstances of OCS development in this region are presented.

C-1660-76
OIL AND GAS DEVELOPMENT IN THE SANTA BARBARA CHANNEL OUTER CONTINENTAL SHELF OFF CALIFORNIA

U.S. Geological Survey. 1976.
Washington, D.C., U.S. Government Printing Office, 1976. FES 76-13, Vol 1-3.

EIS, Offshore development, OCS, Santa Barbara Channel, Environmental effects, Oil-gas leasing

This three volume final environmental impact statement identifies and evaluates probable and potential offshore and onshore effects of oil development in the Santa Barbara Federal OCS lease areas. Four general options of such development are as follows: 1) continued production at present rates; 2) increased production from currently developed leases; 3) exploration and development of all existing leases; and 4) leasing, exploration and development of presently unleased areas.

C-1661-76
POSSIBLE IMPACTS OF OIL SHALE DEVELOPMENT ON LAND RESOURCES

Weaver, G.D. 1974.
Journal of Soil and Water Conservation 29(2):73-76.

Environmental effects, Oil shale development, Contamination, Groundwater, *Colorado River

Unacceptable environmental impacts may result from oil-shale mining and shale waste disposal in the Upper Colorado River Basin. Groundwater as well as surface waters would be affected by oil contamination from the natural leaching of shale wastes or on site processing.

[from Selected Water Resources Abstracts 9(4):#W76-01691. 1976.]

C-1662-76
ENVIRONMENTAL ASPECTS OF PRODUCED WATERS FROM OIL AND GAS EXTRACTION OPERATIONS

Weiss, F.T., and C.D. McAuliffe, and C.B. Koons. 1976.
Offshore Technology Conference, 8th, Houston, 1976. Paper no. OTC-2447. Abstract.

Environmental effects, Wastewater, Offshore production, Marine organisms, Toxicity

The constituents of produced waters from oil and gas extraction and their toxic effects on the marine and coastal environments are reviewed. The study indicates that concentrations of hydrocarbons and inorganic compounds in produced waters are quickly reduced by natural processes, and that these waters have not been found to have detrimental effects on the marine environment.

C-1663-76
ENDANGERED SPECIES: THEIR IMPLICATIONS IN OIL SHALE DEVELOPMENT

Winsor, D.B. 1975.
Colorado School of Mines Quarterly 70(4):153-157.

Oil shale development, Environmental management, Conservation, *Endangered species

The article outlines the U.S. Department of Interior's plan to coordinate with other federal and state agencies certain management procedures that will assure the preservation of endangered species during oil shale development.

[from Petroleum Abstracts 16(16):#218,650. 1976.]

C-1664-76
CONTAMINATION OF AN AQUIFER BY SALT WATER INJECTION

Woods, C.' 1974.
Engineering Bulletin of Purdue University, Engineering Extension
Series 145 (part 1):141-147.

Contamination, Drilling, Texas, *Freshwater aquifer

A study of the Seymour Formation, a fresh water aquifer in north-central Texas, indicates that local contamination of fresh water wells has been caused by unplugged drill holes, surface spillage, and improperly designed, maintained and operated injection wells.

[from Chemical Abstracts 48(12):#79440j. 1976.]

E. FATE OF OIL IN THE ENVIRONMENT

1. BIOLOGICAL DEGRADATION

C-1665-76
MICROBIAL DETERIORATION OF PETROLEUM PRODUCTS AND THEIR PREVENTION BY TOXIC INHIBITORS

Abou-Zeid, and A. Abou-Zeid. 1975.
Zentralblatt fuer Bakteriologie, Parasitenkunde, Infektionskrankheiten und Hygiene, Abt. 2 130(5):491-501.

Microorganisms, Petrochemicals, *Degradation inhibitors

"This article is a review with 17 references dealing with biodegradation of various petroleum products and its inhibition."

[from Chemical Abstracts 84(14):#92367. 1976.]

C-1666-76
SUPER MICROBE EATS MORE OIL

Anon. 1976.
Processing 22(2):7.

Hydrocarbons, Oil spills, Bacteria

A new "supermicrobe", created by genetic engineering from four different strains of naturally occurring bacteria, is designed to biodegrade petroleum to forms that can be utilized by other marine life. The organism can digest about two-thirds of the hydrocarbons involved in an oil spill and can assimilate them several times faster than any other known organism.

[from Petroleum Abstracts 16(17):#218,909. 1976.]

C-1667-76
SUPER-STRAIN OIL BACTERIA (news brief)

Anon. 1976.
Marine Pollution Bulletin 7(2):20.

Oil spills, Cleanup, Bacteria

A "super-strain" bacteria to deal with oil spills has been developed by the U.S. General Electric Company. The organism, still in the laboratory stage, is a combination of four hydrocarbon-degrading bacterial strains and is claimed to digest crude oil several times faster than any other known organism.

C-1668-76
FATE AND EFFECTS OF OIL POLLUTANTS IN EXTREMELY COLD MARINE ENVIRONMENTS

Atlas, R.M. 1975.
Annual report, Contract N00014-74A-180-0001. 42p.

Crude oil, Arctic, Toxicity

The biodegradability of Prudhoe crude oil in the Arctic was studied in flow-through chemostats. The addition of nitrogen and phosphorus enhanced biodegradation. Prudhoe crude, Arctic Diesel and JP5 were shown to be subject to biodegradation at low temperatures by indigenous Arctic microorganisms when nitrogen and phosphorus were added. Crude oil contamination and SO_2 exposure inhibited essential algal and lichen metabolic activities.

[from Government Reports Announcements 76(4):#AD-A018 711/26A. 1976.]

C-1669-76
PETROLEUM BIODEGRADATION IN THE ARCTIC

Atlas, R.M., and E.A. Schofield. 1974.
Symposium-workshop on Impact of the Use of Microorganisms on the Aquatic Environment, Pensacola, Florida, 1974. Bourquin, Meyers, and Ahearn (eds.). Corvallis, Oregon, Office of Research and Development, EPA, 1975. p.183-198. (U.S. Environmental Protection Agency Ecological Research Series, EPA-660/3-75-001)

Emulsification, Microorganisms, Arctic, Alaska

Alaskan arctic waters were found to contain oil-degrading and oil-emulsifying microbial populations comparable to those of temperate Atlantic waters. Biodegradation rates could be enhanced by the addition of P and N fertilizers. Several naturally occurring bacteria and yeasts of the Arctic are being tested as possible seed inocula for increasing oil biodegradation in arctic regions.

[from Aquatic Sciences and Fisheries Abstracts 6(1):#6Q703. 1976.]

C-1670-76
EFFECTS OF HYDROCARBONOCLASTIC YEASTS ON POLLUTANT OIL AND THE ENVIRONMENT

Berner, N.H., D.G. Ahearn, and W.L Cook. 1975.
Symposium-workshop on Impact of the Use of Microorganisms on the Aquatic Environment, Pensacola Beach, Florida, 1974. Bourquin, Meyers, and and Ahearn (eds.). Corvallis, Oregon, Office of Research and Development, EPA, 1975. p.199-219. (U.S. Environmental Protection Agency Ecological Research Series EPA-660/3-75-001)

Emulsification, Hydrocarbons, Yeasts, Estuaries

Although hydrocarbonoclastic yeasts have been suggested for use in emulsifying and degrading residual hydrocarbons from various natural and manmade sites, they have not yet been proven to be practical under field conditions. The effectiveness of the yeasts in utilizing oil varies greatly with environmental conditions and type of oil. The results of yeast-seeding experiments in estuarine environments are discussed.

[from Aquatic Sciences and Fisheries Abstracts 6(1):#6Q704. 1976.]

C-1671-76
CHARACTERISTICS OF A FACULTATIVELY PSYCHROPHILIC ACINETOBACTER SPECIES ISOLATED FROM RIVER SEDIMENT

Brevil, C., T.J. Notitsky, and D.J. Kushner, 1975.
Canadian Journal of Microbiology 21(12):2103-2108.

Crude oil, Bacteria, Rivers, Sediments, *Acinetobacter

A bacterium, Acinetobacter sp., isolated from river sediment was found to be extremely hemolytic and lipolytic. Its action on crude oil was observed; the organism was able to utilize a wide variety of carbon sources at temperatures of 20°C and 30°C.

[from Abstracts on Health Effects of Environmental Pollutants 5(5): #4434. 1976.]

C-1972-76
OXIDATION AND ASSIMILATION OF HYDROCARBONS BY MICROORGANISMS ISOLATED FROM THE MARINE ENVIRONMENT

Cerniglia, C.E. 1975.
Ph.D. Thesis North Carolina University, 65p.

Oxidation, Hydrocarbons, Crude oil, Fungi, Bacteria

Microbial assimilation of crude oil and other hydrocarbons was investigated by using organisms isolated from mud samples that were collected along the North Carolina coast. Fungi utilized oil more efficiently than did bacteria and could assimilate a wide variety of hydrocarbons as sources of carbon and energy. The most effective fungi isolated were C. elegans and P. zonatum. Under experimental conditions C. elegans assimilated over 90% of a paraffin-base crude oil after seven days.

[from Petroleum Abstracts 16(14):#218,154. 1976.]

C-1673-76
MICROBIOLOGICAL ASPECTS OF PETROLEUM DEGRADATION IN THE AQUATIC ENVIRONMENT

Crow, S.A., S.P. Meyers, and D.G. Ahearn. 1974.
Mer (Tokyo) 12(2):95-112.

Hydrocarbons, Microorganisms, Bibliographies

The literature dealing with the effects of crude oil on the microbial ecosystems and the biodegradation of hydrocarbons is summarized. Other topics reviewed are the ecology of hydrocarbon utilizers and the pathways and controlling parameters of hydrocarbon degradation. An extensive bibliography is included.

[from Biological Abstracts 61(18):#42710. 1976.]

C-1674-76
EFFECT OF IRON ON THE BIODEGRADATION OF PETROLEUM IN SEAWATER

Dibble, J.T., and R. Bartha. 1976.
Applied and Environmental Microbiology 31(4):544-550.

Oil slicks, Seawater

Studies on South Louisiana crude oil show ferric octoate, in combination with paraffinized urea and octylphosphate, to be suitable for treatment of oil slicks. Nitrogen and phosphorus were also shown to greatly increase biodegradation in polluted seawater.

C-1675-76
BIODETERIORATION OF PETROLEUM PRODUCTS

Hill, E.C. 1975.
Microbial Aspects of the Deterioration of Materials. R.J. Gilbert and D.W. Lovelock (eds.). New York, Academic Press Inc., 1975. p.127-136.

Petrochemicals, Analytical techniques

Eight test methods for determining the biodegradation of petroleum products in water are given. Sampling and incubation techniques are discussed. The findings of these tests are not necessarily conclusive, but are indicators of potential problems in aquatic systems.

C-1676-76
BIODEGRADABLE OIL (letter to editor)

Kolm, H.H. 1975.
Science News 107(1):3.

Regulations, Emulsification, Crankcase oil, Water quality

The letter reports a new regulation, enacted in 1973 in Switzerland, which prohibits the use of ordinary motor oil in boat engines and requires the use of a biodegradable oil which readily emulsifies with water. The oil also imparts a brown color to oil-gasoline mixtures for inspection and compliance purposes. The use of this oil has resulted in dramatic improvements of water quality in Swiss waters.

C-1677-76
PETROLEUM-OXIDIZING BACTERIA OF THE ENISEI RIVER (English summary)

Koronelli, T.V., and V.E. Golimbet. 1976.
Biologicheskie Nauki (Moscow) 19(1):105-108.

Oxidation, Hydrocarbons, Streams, Bacteria, *Arthrobacter sp., *Mycobacterium sp.

Petroleum-degrading Arthrobacter and Mycobacterium species in Enisei River waters were found to differ in the qualitative composition of free lipids that they form during oxidation of the petroleum hydrocarbon n-hexadecane.

[from Chemical Abstracts 84(19):#132562d. 1976.]

C-1678-76
ISOLATION, IDENTIFICATION, AND SUBSTRATE ASSIMILATION SPECIFICITY OF SOME AROMATIC HYDROCARBON UTILIZING BACTERIA

Omori, T., Y. Jigami, and Y. Minoda. 1975.
Agric. Biol. Chem. 39(9):1775-1779.

Aromatic hydrocarbons, Microorganisms, Bacteria

This study on hydrocarbon-assimilating microorganisms relates to biodegradation of environmental pollutants.

[from Abstracts on Health Effects of Environmental Pollutants 5(5): #4485. 1976.]

C-1679-76
THE UTILIZATION OF HYDROCARBON SUBSTRATES BY AN OBLIGATE THERMOPHILE, THERMOMICROBIUM FOSTERI SP. NOV.

Phillips, W.E., Jr. 1975.
Ph.D. Thesis, North Carolina State University, 90p.

Hydrocarbons, Bacteria, North Carolina, *Thermomicrobium fosteri sp. nov.

A newly discovered thermophilic, aerobic bacterium which occurs in the littoral zone of coastal North Carolina is herein investigated and described. Its temperature range is 42°-70°F with optimal growth at 60°F. The ability of the bacterium to metabolize various hydrocarbon substrates is analyzed and determined under varying temperature conditions.

[from Dissertation Abstracts International, B. 36(8):#3785. 1976.]

C-1680-76

THE RESPONSE OF BACTERIAL POPULATIONS TO ORGANIC POLLUTANTS IN LAKE ONTARIO. THE DEVELOPMENT OF A LABORATORY MODEL INVOLVING OIL DEGRADATION

Pritchard, P.H., and R.M. Ventullo. 1975.
Proceedings of the Rochester Academy of Science 12(4):402-404.

Bacteria, Great Lakes, Models

Summary not available.

[from Bioresearch Index 12(3):#20719. 1976.]

C-1681-76

THE DECONTAMINATION BY CERTAIN MICROORGANISMS OF WATER POLLUTED BY AROMATIC POLYCYCLIC HYDROCARBON

Scassellati-Sforzolini, G., A. Savino, M.N. Lollini, and R. Pasquini. 1975.
Ann Sclavo 16(4):436-437.

Aromatic hydrocarbons, Microorganisms

Summary not available.

[from Abstracts on Health Effects of Environmental Pollutants 5(2): #1940. 1976.]

C-1682-76

METHOD FOR ESTIMATING THE DECOMPOSITION OF HEXADECANE IN THE MARINE ENVIRONMENT

Seki, H. 1976.
Applied and Environmental Microbiology 31(3):439-441.

Hydrocarbons, Bacteria, Chemical analysis, *Hexadecane, Japan, *Tokyo Bay

The article describes a method, based on quantitating $^{14}CO_2$ produced from $[^{14}C]$ hexadecane, for estimating the rate of hexadecane decomposition by bacteria in seawater from the petroleum polluted Tokyo Bay during the summer stagnation period. The decomposition rate at the surface layer of the inner part of the bay during summer, 1974, was 0.1 to 1.3 ug/h per liter seawater. A similar horizontal distribution pattern was seen for the density of hexadecane-decomposing bacteria.

C-1683-76

MICROBIAL DEGRADATION OF EKOFISK OIL IN SEAWATER BY _SACCHAROMYCOPSIS LIPOLYTICA_

Størmer, F.C., and A. Vinsjansen. 1976.
Ambio 5(3):141-142.

Yeasts, *_Saccharomycopsis lipolytica_, *Seeding experiments

The effect of pH and temperature on the acid production during degradation of Ekofisk oil by the yeast _S. lipolytica_ in seawater in the presence of nutrients is described. Final results indicated that the biodegraded sample was dispersed. Most of the organic acids produced have a hydrophobic and hydrophilic part, which makes them useful in dissolving oil into microdroplets.

C-1684-76

THE BIODEGRADABILITY OF SOME ORGANIC POLLUTANTS PRESENT IN THE WASTE WATERS RESULTED FROM THE PETROLEUM REFINERIES (English summary)

Vaicum, L., and L. Stefanescu. 1974.
Studii de Epurarea Apelor 16(1-7):50-75.

Wastewater treatment, Refineries, Toxicity, Microorganisms

The toxicity of sulfonates, mercaptans and naphthenates in refinery wastewaters affects biological treatment methods. Allyl-mercaptan was toxic to microorganisms at 5 mg/l concentrations, sulfonic lyes were toxic at concentrations above 5 mg/l, and naphthenic lyes inhibited microbial respiration at concentrations above 500 mg/l of wastewater.

[from Biological Abstracts 61(9):#51792. 1976.]

C-1685-76
PETROLEUM HYDROCARBONS: DEGRADATION AND GROWTH POTENTIAL FOR ATLANTIC OCEAN SEDIMENT BACTERIA

Walker, J.D., J.J. Calomiris,, T.L. Herbert, and R.R. Colwell. 1976.
Marine Biology 34(1):1-9.

Hydrocarbons, Bacteria, Sediments, Atlantic coast

Microorganisms isolated from sediment samples taken from three stations along a trackline off the North Carolina coast were examined for their ability to degrade a number of petroleum hydrocarbons. Bacteria from samples collected at a depth of 5,000 m showed greater growth and hydrocarbon degradation when cultured in a seawater medium than in media made up with salts solution. Growth of bacteria in sediment samples collected at two stations was suppressed in seawater medium when a 1% mixture of 19 different petroleum hydrocarbons was added.

C-1686-76
ENUMERATION OF PETROLEUM-DEGRADING MICROORGANISMS

Walker, J.D., and R.R. Colwell. 1976.
Applied and Environmental Microbiology 31(2):198-207.

Microorganisms, Bacteria, Yeasts, Fungi, *Enumeration

The effects of various factors, including oil concentration, antibiotics, dyes, and inoculum washes, on total counts of petroleum-degrading bacteria, yeasts and fungi on oil containing media were examined. Specific media found to be best for enumerating these microorganisms are recommended, and suggestions are made regarding the methodology of counting petroleum degraders.

C-1687-76
MEASURING THE POTENTIAL ACTIVITY OF PETROLEUM-DEGRADING BACTERIA

Walker, J.D., and R.R. Colwell. 1976.
Applied and Environmental Microbiology 31(2):189-197.

Bacteria, Hydrocarbons, Chemical analysis

[C^{-14}] hydrocarbons were used to evaluate the hydrocarbon-degrading potential of bacteria in estuarine and marine environments. Amount of mineralization of [C^{-14}] hexadecane can be equated with the total number of petroleum-degrading bacteria and the percentage of the total heterotrophic bacterial population which they represent.

C-1688-76
BIODEGRADATION OF PETROLEUM BY CHESAPEAKE BAY SEDIMENT BACTERIA

Walker, J.D., R.R. Colwell, and L. Petrakis. 1976.
Canadian Journal of Microbiology 22(3):423-428.

Bacteria, Sediments, Chesapeake Bay, Chemical analysis, Hydrocarbons

Degradation products of petroleum-degrading bacteria from oil-free and oil polluted sediments were analyzed and compared using techniques of preferential solubility, column chromatography, gas-liquid chromatography and mass spectrometry. Microorganisms from oil polluted sediments effectively utilized saturated and aromatic hydrocarbons, whereas those from oil-free sediments produced greater quantities of residual asphaltenes.

[from Petroleum Abstracts 16(19):#219,360. 1976.]

C-1689-76
EFFECTS OF POORLY METABOLIZED HYDROCARBONS ON SUBSTRATE OXIDATION BY CLADOSPORIUM RESINAE

Walker, J.D., and J.J. Cooney. 1975.
Journal of Applied Bacteriology 39(2):189-195.

Oxidation, Hydrocarbons, Fungi, *Cladosporium resinae

Twelve hydrocarbons which singly support no or little growth of C. resinae were combined with four substrates which do support growth of the fungus, and their effects on utilization were examined. Of the 48 combinations, eight supported increased O_2 consumption above the level obtained with the oxidizable substrate alone. High ratios of hydrocarbon oxidized to CO_2 to hydrocarbon taken up by the cells resulted. These ratios may be advantageous during petroleum degradation in the natural environment since petroleum components could be degraded without formation of a large biomass.

[from Abstracts on Health Effects of Environmental Pollutants 5(5): #4738. 1976.]

C-1690-76
COMPARISON OF THE BIODEGRADABILITY OF CRUDE AND FUEL OILS

Walker, J.D., L. Petrakis, and R.R. Colwell. 1976.
Canadian Journal of Microbiology 22(4):598-602.

Crude oil, Fuel oil, Bacteria

The ability of two crude and two fuel oils to support growth of a mixed population of estuarine bacteria was examined. Each of the oils supported a unique population of bacteria and yeasts. Low sulfur, high saturate South Louisiana crude oil was highly susceptible to degradation; in contrast, the dense, high sulfur Bunker C fuel oil was strongly recalcitrant to biodegradation.

C-1691-76
ENVIRONMENTAL LIMITATIONS ON THE MICROBIAL DEGRADATION OF HYDROCARBONS IN TEMPERATE LAKES

Ward, D.M. 1975.
Ph.D. Thesis, University of Wisconsin, Madison. 142p.

Bacteria, Lakes, *Nutrient limitations, *Temperature

In temperate lakes, the biodegradation of oil pollutants by naturally occurring heterotrophic bacteria is controlled by environmental conditions such as temperature and nutrient concentrations. For example, in Lake Mendota biodegradation rates were optimal for only one month of the year due to temperature limitation in spring and fall and nutrient limitations in mid-summer. The inhibiting effects of the presence of organic compounds, such as acetate and glucose, on hydrocarbon degradation rates are also investigated.

C-1692-76
SELECTIVE ENRICHMENT PROCESSES IN RESOLVING HYDROCARBON POLLUTION PROBLEMS

Zajic, J.E., and A.J. Daugulis. 1974.
Symposium-workshop on Impact of the Use of Microorganisms on the Aquatic Environment, Pensacola Beach, Florida, 1974. Bourquin, Meyers, and Ahearn (eds.). Corvallis, Oregon, Office of Research and Development, EPA, 1975. p.169-182. (U.S. Environmental Protection Agency Ecological Research Series, EPA--660/3-75-001.)

Hydrocarbons, Microorganisms, Pollution prevention, Toxicity

As naturally occurring hydrocarbon-oriented enrichment systems, biodegrading microorganisms are ubiquitous and present diverse enzymatic capabilities. Any selective microbial hydrocarbon enrichment approach must consider specific hydrocarbons for their toxicity, energy availablitity to microbes, and other constraints on microbial activity.

[from Aquatic Sciences and Fisheries Abstracts 6(1):#6Q702. 1976.]

2. PHYSICAL CHANGES OF OIL

C-1693-76
OIL SPREADING ON COASTAL WATERS

Kim, Y.C. 1974.
Coastal Engineering Conference, 14th, Copenhagen, Denmark, 1974.
Vol. III. p.2260-2267.

Spreading, Oil slicks, Coasts

The area of oil spreading was measured experimentally and the relationships between an oil slick spread area and wind, currents, waves and certain mathematical parameters were investigated. It was found that a small volume of oil spilled in shallow coastal waters spreads more rapidly than in deep water, and that oil slick spreading due to wind and waves seems to be more rapid than that due to waves and currents.

C-1694-76
NUMERICAL MODEL OF DROPLET ENTRAINMENT FROM A CONTAINED OIL SLICK

Zalosh, R.G., and D.S. Jensen. 1975.
ASME Winter Annual Meeting, Houston, 1975. New York, ASME, 1975.
p.17-27.

Models, Oil slicks, Entrainment

A theoretical analysis of oil droplet entrainment from a contained oil slick moving relative to water has been performed as a function of relative oil-water velocity. The completed and measured critical values for entrainment agree.

[from The Engineering Index Monthly 14(3):#021221. 1976.]

3. CHEMICAL CHANGES OF OIL

C-1695-76
SOME CHEMICAL AND PHYSICAL ASPECTS OF THE FATE OF CRUDE OIL IN THE MARINE ENVIRONMENT

Burwood, R., and G.C. Speers. 1974.
Advances in Organic Geochemistry 1973. B. Tissor, and F. Bienner (eds.). Paris, France, Editions Technip, 1974. p.1005-1027.

Dispersion, Weathering, Crude oil

Processes relating to the dispersion and weathering of crude oil in the environment are discussed. Based on experimental simulation of crude oil dissolution in seawater, a possible scheme for the transformation of certain hydrocarbons by oxidation processes is suggested.

C-1696-76
ANAEROBIC DECOMPOSITION OF OIL IN BOTTOM SEDIMENTS

Shelton, T.B., and J.V. Hunter. 1975.
Journal of the Water Pollution Control Federation 47(9):2256-2270.

Decomposition, Sediments, *Anaerobic conditions

"Research shows that under anaerobic conditions, there is a greater loss of total organic carbon and oxycompounds (aldehydes, ketones, carboxylic acids) than under aerobic conditions. Oils are more readily lost than other organics."

[from Industrial Wastes Information Bulletin 6(4):#HMS5971. 1976.]

4. GENERAL FATE OF OIL

C-1697-76
HYDROCARBONS IN OPEN OCEAN WATERS

Brown, R.A. and H.L. Huffman, Jr. 1976.
Science 191 (4229):847-848.

Hydrocarbons, Evaporation, Biodegradation, Weathering, *Dissolution, *Ocean waters

Nonvolatile hydrocarbons appear to persist in open oceans to varying degrees, the cycloparaffins and the isoparaffins being most persistent. The aromatics appear to be selectively removed from ocean water. Evaporation and dissolution may account for loss of some of the C_{10} and lighter aromatics. Other processes, such as chemical or biological degradation and absorption by particulate matter, may be responsible for removal of C_{14} and heavier aromatics.

C-1698-76
OIL SPILL DRIFT FORECASTING MODEL

Cole, C.R., H.P. Foote, and J.R. Eliason. 1974.
Water-1974: I. Industrial Wastewater Treatment. G.F. Bennett (ed.).
New York, American Institute of Chemical Engineers, 1974. p.261-269.
(AICHE Symposium Series Vol.70, no.144.)

Models, Oil slicks, Drift, Movement, Dispersions

A mathematical forecasting model is developed which qualitatively simulates the movement and spreading of oil slicks on the ocean surface, and takes into consideration such parameters as permanent ocean currents, tidal currents and winddrift. The model depicts the general size, shape, movement, dispersion and breakup of an oil spill and can be used to estimate the amount of oil and its time of arrival at hypothetical or real shorelines.

C-1699-76
PETROLEUM COMPOUNDS IN THE MARINE FOOD WEB: SHORT-TERM EXPERIMENTS ON THE FATE OF NAPHTHALENE IN _CALANUS_

Corner, E.D.S., R.P. Harris, C.C. Kilvington, and S.C.M. O'Hara. 1976.
Journal of the Marine Biological Association of the United Kingdom
56(1):121-133.

Hydrocarbons, Food web, Crustaceans, *_Calanus helgolandicus_ Claus, *Naphthalene, *Depuration

Dietary route of entry of [1-^{14}C] naphthalene in adult female C. helgolandicus Claus was shown to be more important quantitatively than direct uptake from solution. After naphthalene had been accumulated directly from solution in seawater, depuration was rapid; less than 5% of the radioactivity could be detected after 10 days. By contrast, at the end of this period a third of the naphthalene remained in the animals when the hydrocarbon was taken up by way of food. Over 90% of the radioactivity was present at the end of a 24-hour experiment in which Calanus were fed on the labelled diets.

C-1700-76
LITERATURE REVIEW: MOVEMENT OF SPILLED OIL AT SEA

Fallah, M.H. and R.M. Stark. 1976.
Marine Technology Society Journal 10(1):3-18.

Movement, Oil spills, Bibliographies, Spreading, Cleanup, Decomposition

This paper provides an overview of some of the important studies dealing with the spreading, drift, diffusion and dissipation of oil spilled on water. It is followed by comprehensive bibliographies dealing with the detection, movement, containment, cleanup and degradation of oil spills.

C-1701-76
RANDOM DRIFT OF AN IDEALIZED OIL PATCH

Fallah, M.H., and R.M. Stark. 1976.
Ocean Engineering 3(2):83-98.

Models, Oil slicks, Drift, Spreading

Spilled oil at first forms an oil slick which spreads radially under the influence of inertial forces and is accompanied by partial evaporation, biodegradation, sinking or emulsification. As radial spreading subsides, the oil forms a thin, fairly uniform floating mass called an oil patch. This paper develops simple, stochastic models for predicting the random drift of an idealized oil patch on water due to wind and water currents.

C-1702-76
THE FATE OF CRUDE OIL SPILLS AND THE SITING OF FOUR SUPERTANKER PORTS

Harrison, W. 1974.
Canadian Geographer 18(3):211-231.

Environmental effects, Ports, Oil spills, Bahamas, Canada

An evaluation of the environmental vulnerability of a proposed oil superport must include careful analysis and prediction of the transport, spreading and weathering of possible crude oil spills. Analytical techniques used in the evalution of four such sites in the Bahamas and in northeastern Canada are reviewed.

[from Ecological Abstracts 75(5):#3247. 1976.]

C-1703-76
HYDROCARBONS

Higgins, I.J., and R.G. Burns. 1975.
The Chemistry and Microbiology of Pollution. London, Academic Press, 1975. p.111-139.

Hydrocarbons, Analytical techniques, Biodegradation, Weathering, Biological effects, Environmental effects

This chapter is a comprehensive review of the petroleum hydrocarbons, petrochemicals and other hydrocarbons. Included is a brief review of their chemistry, analytical techniques, such as chromatography and spectroscopy, and microbial and nonbiological degradation. Microbiological aspects of the fate and behavior of petroleum hydrocarbons in the environment and their effects on macroscopic marine and nonmarine flora and fauna are also considered.

C-1704-76
BENZENE, ENVIRONMENTAL SOURCES OF CONTAMINATION, AMBIENT LEVELS, AND FATE

Howard, P.H., and P.R. Durkin. 1974.
Final Report, EPA-560/5-75-005, PB-244139/2, Contract EPA-68-01-2679. 73p.

Environmental effects, Oil spills, *Benzene

The report is a review of available information pertaining to contamination of the environment by benzene. More than half of the benzene released to the environment is from motor vehicle emissions; the remainder is from commercial production and use and from oil spillage.

[from Scientific and Technical Aerospace Reports 14(6):#15675. 1976.]

C-1705-76

FATE AND EFFECTS OF OIL ON LAND AND IN FRESH WATERS

Hubbard, E.H. 1975.
World Petroleum Conference, 9th, Tokyo, 1975. Vol.6. p.289-296.

Oil spills, Inland, Toxicity, Biodegradation

Recent advances in understanding the behavior of oil spilled on soil or inland waters are summarized. The fate of oil on still and flowing waters, oil in groundwater, toxicity, and biodegradation of oil are among the topics discussed.

[from Petroleum Abstracts 16(20):#219,579. 1976.]

C-1706-76

THE INFLUENCE OF COASTAL FRONTS ON THE MOVEMENT AND DISPERSION OF OIL SLICKS

Klemas, V., G. Davis, and S. Kupferman. 1975.
NASA-CR-145581, Contract NAS5-20983. 2p.

Oil slicks, Movement, Estuaries, Coasts, Delaware Bay

Estuarine and coastal fronts are major hydrographic boundaries in Delaware Bay and other estuaries. Surface oil slicks sampled at frontal convergence zones near boundaries contain concentrations of Cr, Cu, Fe, Hg, Pb and Zn which exceed average ocean levels by two to four orders of magnitude.

[from Scientific and Technical Aerospace Reports 14(3):#42430. 1976.]

C-1707-76

FATE OF PETROLEUM COMPONENTS IN A CONTROLLED ENVIRONMENT

Lytle, J.S. 1973-1974.
Journal of the Mississippi Academy of Sciences XIX(1973-1974):181.

Hydrocarbons, Chemical analysis, Sediments

Experiments were conducted in which simulated petroleum pollutants, spiked with C-14 labeled C_{18} acid, alcohol and hydrocarbon, were added to sediments from "clean" coastal bays in order to assess the role of sedimentary processes and to investigate their interconversion. Analysis of extracts removed from the simulated oxygenated sediments showed decreased hydrocarbon/total lipid weight ratio and changed hydrocarbon distribution when compared to the reducing sediments.

C-1708-76
ICES PETROLEUM HYDROCARBONS WORKSHOP

McIntyre, A.D. 1976.
Marine Pollution Bulletin 7(2):19.

Monitoring, Environmental effects, Biological effects, *Workshop

A workshop designed to review current knowledge of petroleum in the marine environment and to promote discussion on current problems and future research was held in Aberdeen from 9-12 September 1975, sponsored by the International Council for the Exploration of the Sea. Thirty-two papers were presented dealing with methodology, occurrence of oil in the physical environment and in the biota, the physical, chemical and biological fate of oil in the sea, and effects on the environment and marine living resources.

C-1709-76
FATE AND EFFECTS OF OIL ON MARINE LIFE: PROGRESS REPORT ON RESEARCH SPONSORED BY THE PETROLEUM INDUSTRY

Mertens, E.W., and A.H. Lasday. 1976.
Offshore Technology Conference, 8th, Houston, 1976. Paper no. OTC-2449. Abstract.

Environmental effects, Biological effects, Marine organisms, Shorelines

An oil industry-sponsored, comprehensive program concerning the fate and effects of oil in the marine environment reports the following preliminary results: organisms release oil contaminants quickly after exposure to an oil spill has ended, and thereby do not concentrate it and pass it up the food chain. Also, the composition of oil changes rapidly after spillage, and the most toxic, volatile aromatic hydrocarbons evaporate rapidly. By this process, the relatively inert residual hydrocarbons are left, which may or may not reach the biologically most sensitive intertidal shoreline zone.

C-1710-76
RECENT ADVANCES IN UNDERSTANDING THE EFFECTS OF OIL IN THE MARINE ENVIRONMENT

Mertens, E.W., and L.P. Haxby. 1975.
World Petroleum Congress, 9th, Tokyo, 1975. Vol.6. p.305-313.

Biological effects, Oil spills, Marine organisms

Research results of a four-year American Petroleum Instutute program on the fate and biological effects of oil spills in the marine environment are summarized. This research does not support the widespread concern that marine organisms concentrate petroleum constituents indefinitely and pass them up the food chain.

[from Petroleum Abstracts 16(20):#219,578. 1976.]

C-1711-76
A COMPUTER SIMULATION TECHNIQUE FOR OIL SPILLS OFF THE NEW JERSEY-DELAWARE COASTLINE

Miller, M.C., J.C. Bacon, and I.M. Lissauer. 1975.
Final report, CGR/DC-24/75, USCG-D-171-75. 50p.

Models, Oil slicks, Movement, Atlantic coast, Delaware, New Jersey

Mathematical models were used to predict the movement of oil slicks and their impact locations along the New Jersey-Delaware shorelines for two potential deepwater ports and two potential drilling sites.

[from Government Reports Announcements 76(4):#AD-A018 947/2GA. 1976.]

C-1712-76
OFFSHORE APPLICATIONS OF MODELLING TECHNIQUES. PART 3. CONCLUSIONS AND APPLICATIONS TO THE NORTH SEA

Willums, J.O., and R.J. Stewart. 1976.
Northern Offshore 5(1):35-36, 38.

Models, Oil spills, North Sea, Contingency planning

Oil spill modelling helps to develop valid oil spill scenarios by enabling predictions of spill drift directions and velocities. Oil spill modelling can be an important environmental planning tool for training, coordinating, and planning for disaster preparedness and for predicting possible oil damage to an area.

[from Petroleum Abstracts 16(16):#218,663. 1976.]

C-1713-76
GENESIS AND DEGRADATION OF PETROLEUM HYDROCARBONS IN MARINE ENVIRONMENTS

Yen, T.F. 1975.
Marine Chemistry in the Coastal Environment. T.M. Church (ed.).
Washington, D.C., American Chemical Society, 1975. p.231-266.
(ACS Symposium Series, 18.)

Decomposition, Biodegradation, Hydrocarbons

"A review with 55 references on the genesis and degradation of petroleum, natural gas, asphalt and kerogen in marine environments."

[from Chemical Abstracts 84(16):#108070w. 1976.]

C-1714-76
COMPOSITIONAL CHANGES OF A FUEL OIL FROM AN OIL SPILL DUE TO NATURAL EXPOSURE

Young, R.N., and A.J. Sethi. 1975.
Water, Air and Soil Pollution 5(2):195-206.

Decomposition, Oil spills, Fuel oil, Weathering, Soil

The study determined the compositional changes of spilled oil undergoing oxidation and physical weathering in soil (beach sand) over a period of one year. It was found that about 3.5% of the oil was still retained in the soil after the year period.

F. OIL POLLUTION REGULATIONS

1. U.S. LEGISLATION

C-1715-76
LAW COURT RULINGS OF MAJOR IMPORTANCE IN 1974

Anon. 1975.
Shipping World and Shipbuilder 168(3901):55-56.

Legislation, Pollution prevention, *Litigation

The article briefly examines and reviews oil pollution litigations of 1974 which involved interpretations of the Oil in Navigable Waters Act as amended in 1963, and the Prevention of Oil Pollution Act of 1971.

[from Oceanic Abstracts 13(1):#904. 1976.]

C-1716-76
QUALITY ASSURANCE FOR GROUNDWATER

Anon. 1976.
Environmental Science and Technology 10(3):226-227.

Groundwater, Contamination, Drilling, Water quality

A large portion of groundwater contamination can stem from oil and gas operations, especially where secondary and tertiary oil recovery is taking place. The Safe Drinking Water Act of 1974 provides a statutory mandate for establishment of state programs for protection of underground drinking water sources from subsurface injection and other sources of contamination. The provisions of this Act and efforts by industry and international organizations to ensure groundwater quality are discussed.

C-1717-76
CONGRESS PONDERS BILL THAT WOULD RESHAPE THE OFFSHORE OIL INDUSTRY

Cozens, A. 1976.
Offshore 36(5):107-109.

U.S. Government, Legislation, Offshore development, OCS, Environmental protection, Liability, Oil spills

Bills have been introduced in the House (HR-6218) and Senate (S-521) which seek to change existing OCS petroleum lease regulations in order to increase government revenues, promote competition, maximize resource development, and preserve the environment. Proposed environmental stipulations include detailed environmental impact reports and reviews, penalties for violation of safety regulations, and establishment of an oil spill liability fund of up to $200 million for cleanup and spill damage payments.

C-1718-76
ELEMENTS OF AN ADEQUATE ENVIRONMENTAL IMPACT STATEMENT FOR THE PETROLEUM, PETROCHEMICAL AND BULK ENERGY INDUSTRIES

Jimeson, R.M. 1975.
World Petroleum Congress, 9th, Tokyo, 1975. Vol. 6. p.223-228.

EIS, Industries, Petroleum industry

According to provisions of the National Environmental Policy Act, environmental impact statements must be prepared before major federal action is taken. The necessary scope and depth of such reports and emerging policy trends relating to the petroleum and petrochemical industry are discussed.

[from Petroleum Abstracts 16(20):#219,577. 1976.]

C-1719-76
LEGAL ASPECTS OF OIL POLLUTION

Kuffler. December, 1975.
Society of Naval Architects and Marine Engineers Spring Meeting, 1975.

Legislation, Oil discharges

Summary not available. (May be purchased from SNAME, 74 Trinity Place, New York, N.Y. 10006.)

[from Marine Technology 12(4):471. 1976.]

C-1720-76
UNITED STATES COAST GUARD POLLUTION PREVENTION REGULATIONS

Lutz. October, 1974.
Society of Naval Architects and Marine Engineers, Pacific Northwest, local section paper.

Regulations, Pollution prevention, Tankers, Oil transport

Summary not available. (May be purchased from SNAME, 74 Trinity Place, New York, N.Y. 10006.)

[from Marine Technology 12(4):471. 1976.]

C-1721-76
WATER POLLUTION CONTROL ACT OF 1972. ECONOMIC IMPACTS, PETROLEUM REFINING INDUSTRY

Smith, J.L., and R.A. Leone. 1975.
Final report, NCWQ-75/16, Contract WQ4AC013. 251p.

Legislation, Petroleum industry, Refining, Economic effects

Of the 250 refineries operating in the U.S. and Puerto Rico as of January 1, 1974, less than 1 percent is likely to be endangered by the effluent limitations established by the EPA under the Federal Water Pollution Control Act of 1972. Consumer demand for petroleum products appears strong enough to absorb pollution abatement cost increases for the remaining 99 percent.

[from Government Reports Announcements 76(7):#PB-248 800/5GA. 1976.]

2. INTERNATIONAL LEGISLATION

C-1722-76
No title given (news brief)

Anon. 1976.
Chemical Engineering 83(5):61.

International agreements, Mediterranean Sea, Oil discharges, Oil spills

Sixteen Mediterranean countries have worked out two protocols formally established February 17, which prohibit the dumping of certain materials and provide for international cooperation whenever a major environmental threat such as an oil spill becomes known. The list of totally prohibited materials to be dumped in the sea includes persistent plastics, radioactive wastes, crude oil and petroleum-derived products. The agreement provides for establishing an oil-combatting center in Malta of which the main task will be to disseminate information about major oil spills.

C-1723-76
MARINE POLLUTION: HIGH SEAS INTERVENTION

Anon. 1975.
Bulletin of Legal Developments No. 9:91. Summary.

International conventions, Oil spills, Liability

"The International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties, signed Nov. 29, 1969, became effective May 6, 1975. The International Convention on Civil Liability for Oil Pollution Damage, signed Nov. 29, 1969, will become effective on June 19, 1975."

[from Oceanic Abstracts 13(1):#973. 1976.]

C-1724-76
MARINE POLLUTION: SEABED ACTIVITIES

Anon. 1975.
Bulletin of Legal Developments No. 10:100. Summary.

International agreements, Liability, Oil spills, North Sea

"Under the Offshore Pollution Liability Agreement, signed by 27 oil companies Sept. 4, 1974, and in force May 1, 1975,≤ L6.8 million will be available for clearance and compensation costs for oil spills from North Sea oil rigs."

[from Oceanic Abstracts 13(1):#975. 1976.]

C-1725-76
THE PREVENTION OF POLLUTION FROM SHIPS

Anon. 1974.
National Parks and Conservation Magazine 48(1):2-3.

International conventions, Oil discharges, Tankers, Load-on-top, *Double bottoms

The shortcomings of the International Convention for the Prevention of Pollution from Ships, London, 1973, are discussed. Decisions made concerning segregated ballast for ships did not include large ships presently under contract and did not cover problems of oil discharges for small vessels. The proposal regarding requirement of double bottoms was rejected. The Convention requires all tankers to have Load-on-top capability; nonetheless, it permits the intentional discharge of oil at sea. The enforcement procedures established by the Convention are very weak.

[from Environmental Periodicals Bibliography 4(3):#8536. 1976.]

C-1726-76
THE IMPACT OF THE 1973 IMCO CONVENTION ON THE MARITIME INDUSTRY

Benkert, W.M., and D.H. Williams. 1974.
Marine Technology 11(1):1-8.

International conventions, Oil transport, Pollution prevention, Oil discharges, Tankers, Oil spills

This paper reviews some of the major provisions of the International Convention for the Prevention of Marine Pollution, 1973, and considers their impact on the shipbuilding and maritime transportation industries.

C-1727-76
IMPLEMENTATION AND ENFORCEMENT OF CONVENTIONS RELATING TO THE PREVENTION OF MARINE POLLUTION FROM SHIPS

Khalimonov, O.N. 1975.
Petroleum and Environmental Conservation. International Petroleum Industry Environmental Conservation Association, 1975. p.183-197, 210-213.

International conventions, Law enforcement, Tankers, Pollution prevention, Monitoring, Oil discharges

The acceptance of conventions, including the International Convention for the Prevention of Pollution of the Seas by Oil, and its amendments of 1962, 1969, and 1971, by most of the world's oil tanker fleet is reviewed. Technical problems relating to inspection, monitoring of oil discharges, detection of violations, and enforcement are also considered.

[from Pollution Abstracts 7(2):#76-01303. 1976.]

C-1728-76
THE INTERNATIONAL LAW COMMISSION AND INTERNATIONAL ENVIRONMENTAL LAW

Ramcharan, B.G. 1976.
Ocean Management 2(1975):315-322.

International conventions, Pollution prevention, Oil discharges, *International Law Commission

This paper describes the work of the International Law Commission concerning pollution of the high seas, pollution of international watercourses, and international responsibility for environmental hazards. One of The Commission's draft articles of 1956 on the Law of the Sea, which concerns regulations to prevent pollution of the seas by the discharge of oil and radioactive waste, is mentioned.

C-1729-76
INTERNATIONAL PROTECTION OF THE ENVIRONMENT: TREATIES AND RELATED DOCUMENTS. VOL. 1

Ruesta, B., and B. Simma (eds.). 1975.
Dobbs Ferry, N.Y., Oceana Publications. 1975. 489p.

International Conventions, Environmental protection, Conservation

This publication presents extracts of international measures which deal with the preservation and conservation of the natural environment. Included is the 1954 London International Convention for the Prevention of Pollution of the Sea by Oil, and its later amendments.

C-1730-76
INTERNATIONAL CONVENTION FOR THE PREVENTION OF POLLUTION FROM SHIPS (1973)

Walton, A. 1974.
Water-1974: I. Industrial Wastewater Treatment. G.F. Bennett (ed.). New York, American Institute of Chemical Engineers, 1974. p.237-242. (AICHE Symposium Series, Vol. 70, no. 144.)

International conventions, Pollution prevention, Ships, Tankers, Oil discharges

The article briefly reviews and outlines the major provisions of the 1973 International Convention for the prevention of pollution from ships. The provisions call for a number of specific regulations to prevent or control the discharge of oil, oily wastes, and non-oily noxious liquid substances into the marine environment.

3. FOREIGN LEGISLATION

C-1731-76
ALBERTA MAY BE SAFEST DRILLING REGION WITH NEW BLOWOUT PREVENTER REGULATIONS

Anon. 1976.
OilWeek 27(3):44,46,48.

Regulations, Blowout prevention, Drilling, Canada, *Alberta

New blowout prevention regulations, which will enforce the use of more reliable equipment developed in recent years, are designed to reduce to the lowest practical minimum the number of blowouts and associated waste of energy and environmental damage.

[from Petroleum Abstracts 16(16):#218,476. 1976.]

C-1732-76
LEGAL CONTROLS AND LEGISLATION

Wisdom, A.S. 1975.
Pollution Criteria for Estuaries, Proceedings of the Conference held at the University of Southampton, 1973. P.R. Helliwell and J. Bossanyi (eds.). London, Pentech Press, 1975. p.2.1-2.13.

Legislation, Great Britain, Oil discharges, Estuaries, Tankers, Bilges

The legislation and administrative measures relating to the following forms of estuarial pollution are discussed: polluted river waters entering the estuary, sewage and industrial effluents, crude sewage, bilge contents etc. from vessels, dumping of waste materials offshore, discharge of sludge through pipelines, oil from tankers, offshore installations, and toxic substances drifting ashore from wrecks.

4. STANDARDS AND GUIDELINES

C-1733-76
CONTROLLING OIL SPILLS-THE BENEFITS OF COLLABORATION BETWEEN INDUSTRY, SCIENTISTS AND PUBLIC AUTHORITIES

Bauer, M. 1975.
World Petroleum Congress, 9th, Tokyo, 1975. Vol.6:325-331.

Guidelines, Germany, West, Pollution prevention, Regulations, Personnel training, Design and engineering

The paper summarizes the efforts of the German federal government to establish guidelines in preventing oil pollution, and to promote and coordinate research efforts by various industrial, scientific and administrative groups. Subjects of concern include technical regulations, personnel training, equipment design, and reporting and analysis techniques.

[from Petroleum Abstracts 16(20):#219,581. 1976.]

C-1734-76
EUROPEAN MODEL CODE OF SAFE PRACTICE FOR THE PREVENTION OF GROUND AND SURFACE WATER POLLUTION BY OIL FROM STORAGE TANKS AND DURING THE TRANSPORT OF OIL

European Petroleum Organisations. 1974.
London, England, Applied Science Publishers Ltd., 1974. viii + 24p.

Guidelines, Pollution prevention, Groundwater, Oil transport, Storage, Europe

This is one of a series of codes designed to achieve closer European cooperation in prevention of ground and surface water pollution by oil. The code contains guidelines for preventing spills and pollution from above ground and buried storage tanks, connector pipes and fittings. The guidelines also cover the transfer, transport and delivery of oil on land and water.

C-1735-76
COASTAL ZONE POLLUTION BY OIL AND OTHER CONTAMINANTS: GUIDELINES FOR POLICY, ASSESSMENT AND MONITORING IN TROPICAL REGIONS. BASED UPON A CASE STUDY IN INDONESIA, IN 1973

Freeman, P.H. 1974.
Contract AID/csd-2608. 144p.

Guidelines, Pollution prevention, Coasts, Indonesia, Bibliographies, *Tropical Regions

The report provides guidelines useful to tropical nations for the prevention and control of coastal pollution by oil and other contaminants. Included is an Annotated Bibliography on the Biological and Ecological Effects of Oil Pollution in Tropical Waters.

[from Government Reports Announcements 76(4):#PB-247 433/6GA. 1976.]

C-1736-76
PROTECTION OF THE MARINE ENVIRONMENT

National Petroleum Council. 1975.
Natural Resources Lawyer 8(3):511-543.

Environmental effects, Oil spills, Cleanup, International conventions, Environmental protection, *Safety standards

Sources and kinds of marine pollution and oil spill containment and cleanup are discussed. The environmental impact of petroleum in the oceans is assessed. The National Petroleum Council recommends that the Law of the Sea Convention should designate IMCO as the international forum where governments should establish safety and pollution standards for vessels and all petroleum and other commercial facilities operating in the marine environments.

[from Environment Abstracts 6(4):#76-02772. 1976.]

C-1737-76
PUBLISHED REGULATORY GUIDELINES OF ENVIRONMENTAL CONCERN TO THE OIL INDUSTRY IN WESTERN EUROPE

Stichting CONCAWE. 1976.
The Hague, Stichting CONCAWE, Report No. 1/76. 35p.

Petroleum industry, Regulations, Pipelines, Wastewater treatment, Europe

This revised report gives details of relevant environmental regulations of fuel-oil sulfur content, gasoline engine emissions, noise control, oil pipelines, and wastewater effluents.

[from The Marine Pollution Bulletin 7(2):39. 1976.]

G. BIBLIOGRAPHIES

C-1738-76
BIODETERIORATION OF OIL SPILLS (A BIBLIOGRAPHY WITH ABSTRACTS)

Harrison, E.A. 1976.
NTIS/PS-76/0032/3GA. 104p.

Biodegradation, Decomposition, Oil spills, Cleanup

This updated bibliography of 99 abstracts (including 18 new entries) presents government-sponsored research on petroleum-degradation, oil spills, cleanup operations, microbial degradation, and hydrocarbons.

[from Government Reports Announcements 76(6):45. 1976.]

C-1739-76
THE BIOLOGICAL EFFECTS OF OIL SPILLS (A BIBLIOGRAPHY WITH ABSTRACTS)

Harrison, E.A. 1976.
NTIS/PS-76/0033/1GA. 104p.

Biological effects, Oil spills, Environmental effects

This updated bibliography of 142 abstracts (including 35 new entries) summarizes government-sponsored research covering all aspects of the ecological and biological effects of oil spills in water.

[from Government Reports Announcements 76(6):45. 1976.]

SECTION II: CURRENT RESEARCH PROJECTS

Title, contract information and a summary of project objectives are provided in each entry. Project notices were obtained from the Smithsonian Science Information Exchange (SSIE), Maritime Research Information Service Abstracts, Aquatic Microbiology Newsletter, and Environmental Research, American Petroleum Institute Annual Status Report. Current status information and publications resulting from the projects are presented when such information is available from the principal investigators or performing organizations. The source of status information is given at the end of each entry.

Entries are grouped according to subject and then ordered by serial number within each subject division. The serial number designates the original issue of OIL SPILL AND OIL POLLUTION REPORTS in which the research project is listed:

R-001-74 to R-165-74	EPA-670/2-75-003 July to October 74
R-166-74 to R-244-74	EPA-670/2-75-004 November 74 to February 75
R-245-74 to R-268-74	EPA-670/2-75-059 February 75 to April 75
R-269-74 to R-342-74	May 75 to July 75
R-269-74 to R-304-75	August 75 to October 75
R-035-76 to R-063-76	February 76 to April 76
R-064-76 to R-123-76	May 76 to July 76

A. OIL POLLUTION DETECTION AND EVALUATION

1. REPORTING

R-064-76
COMPUTERIZE INFORMATION ON WORLD-WIDE OIL SPILLS

Principal Investigator: Whitman, J.
Performing Organization: Smithisonian Institute, 900 Jefferson Dr., S.W., Washington, D.C. 20560
Supporting Agency: U.S. Environmental Protection Agency, Office of Research and Development
Period: 5/75 to 11/76 Funds: $1,064

The project involved developing a computerized data base system that could contain selected characteristics of spills of oil and other hazardous substances. Fifty-seven oil spills occurring in 32 areas of the world from 1962 to 1975 were selected to develop the data base. Spill characteristics include name, date, time, location of occurrence, type and amount of substance spilled, source and cause, cleanup characteristics, and vessel information.

[SSIE No. GMA-2331]

Status: The Spill Directory is being updated and expanded under contract with the Environmental Protection Agency. This project is due for completion by November, 1976; however, documentation on spills is expected to continue indefinitely.

The spill project includes developing an international network of scientists and other professionals interested in exchanging current research reports on the environmental, economic, social and cleanup aspects of spills taking place in the world. The network,called Interspill, will be coordinated through Strategic Environmental Planning. Composite summaries of spill research on selected spills will be printed for dissemination to all participants. Periodic summary research reports on particular spills, which will be available at a cost to interested parties, will be prepared.

Spill information collected in the Spill Directory is computerized in an "electronic file cabinet system." Information is stored in testual or narrative form. The computerized system is being developed to allow on-line interaction with the file and will be capable of responding to particular inquiries about spill characteristics, spill research results, and personnel involved in studying the various aspects of spill impacts and management around the world.

Information Source: J. Whitman, Director, Strategic Environmental
Planning, P.O. Box 162, Concord, MA 10742

2. MONITORING

R-065-76
BASELINE AND MONITORING OF ALIPHATIC AND AROMATIC HYDROCARBONS IN THE NORTHEASTERN GULF OF MEXICO

Principal Investigator: Lytle, J.S.
Performing Organization: Gulf Coast Research Laboratory, P.O. Drawer AG, Ocean Springs, MS 39564
Supporting Agency: Department of the Interior, Bureau of Land Management
Period: Unknown

Summary not available.

[American Society for Microbiology, Aquatic Microbiology Newsletter 15(1):33]

Reports and Publications

FATE AND EFFECTS OF CRUDE OIL ON AN ESTUARINE POND

Lytle, J.S. 1975.
Conference on Prevention and Control of Oil Pollution, San Francisco, 1975. p.595-600.

Both short and long term effects of crude oil were observed on salt marsh plants, fish populations, and zooplankton. Oil migrated 42 cm beneath the sediment surface, carried both by benthic organisms and tidal percolations. Sediment analyses indicates slow degradation of the crude oil.

FATE OF PETROLEUM COMPONENTS IN A CONTROLLED ENVIRONMENT

Lytle, J.S. 1973-1975.
Journal of the Mississippi Academy of Sciences XIX(1973-1974): 181.

Experiments were conducted in which simulated petroleum pollutants spiked with C-14 labeled C_{18} acid, alcohol and hydrocarbon were added to sediments from "clean" coastal bays in order to assess the role of sedimentary processes and to investigate their interconversion. Analysis of extracts from the simulated oxygenated sediments showed decreased hydrocarbon/total lipid weight ratio and changed hydrocarbon distribution when compared to the reducing sediments.

Information Source: J.S. Lytle, Gulf Coast Research Laboratory, P.O. Drawer AG, Ocean Springs, MS 39564

3. REMOTE SENSING

R-066-76
FLIGHT TEST EVALUATION OF SCARE R217A RADAR

Principal Investigator: Unknown
Performing Organization: U.S. Navy, Air Systems Command, Washington, D.C. 20360
Supporting Agency: U.S. Department of Transportation Coast Guard
Period: 7/74 to 6/75 Funds: $107,000

"Detection of moving targets, the production of high resolution ground map and to demonstrate detection sensitivity for the Navy as well as oil spills and the detection of small boats for the Coast Guard's pollution control and search and rescue missions."

[SSIE No. GZ-56000]

R-067-76
MULTI-SPECTRAL ACTIVE PASSIVE SCANNER (MAPS) OIL SPILL SURVEILLANCE SYSTEM

Principal Investigator: Unknown
Performing Organization: Baird Atomic, Inc., 125 Middlesex Turnpike, Bedford, MA 01730
Supporting Agency: U.S. Department of Transportation, Coast Guard
Period: 7/74 to 6/75 Funds: $59,119

Research is aimed at optimizing MAPS for oil spill detection and measuring harbor and oil parameters to provide a data base for design of a low-cost harbor monitor.

[SSIE No. GZ-58127]

Status: Baird-Atomic has completed the current phase of the project. The company is continuing a low level internally funded study of advanced techniques for oil surveillance.

Reports and Publications

OPTIMIZATION AND EVALUATION OF A FLUORESCENCE OIL SPILL DETECTOR. VOLUME 2. PROTOTYPE DESIGN

Eldering, H.G., and W.A. Webb. 1975.
Final report, No. 5/75-62633-Vol-2, USCG-D-109-75, Contract DOT-CG-43845. 30p.

The operational and technical requirements of a low cost harbor surveillance unit are discussed. Consideration of coverage during the design of a Scanning Oil Spill Detector resulted in a design containing both azimuth and elevation scanning. This design costs less than the addition of units to provide the increased coverage.

OPTIMIZATION AND EVALUATION OF A FLUORESCENCE OIL SPILL DETECTOR. VOLUME 1. LABORATORY MEASUREMENTS AND FIELD EVALUATION

Webb, W.A., and H.G. Eldering. 1975.
Final report, No. 5/75-6233-Vol-1, USCG-D-108-75, Contract DOT-CG-43845-A. 108p.

The objective of this research was to maximize the detection range of an automatic fluorescence oil spill detector and to evaluate its capabilities. The fluorescence spectral distributions and intensities of 22 oils were compared. On the basis of measurements in two spectral regions, oil fluorescence can be consistently discriminated from marine fluorescence.

Information Source: H.G. Eldering, Baird-Atomic, Inc., 125 Middlesex
Turnpike, Bedford, MA 01730

4. ANALYSIS

R-028-74
EXAMINATION OF CHEMICAL AND PHYSICAL PROPERTIES OF ALL TYPES AND SOURCES OF OILS AND PRODUCTS BY VARIOUS TYPES OF INSTRUMENTATION

Principal Investigator: Kawahara, F.K.
Performing Organization: U.S. Environmental Protection Agency,
National Environmental Research Center,
Cincinnati, OH 45268
Supporting Agency: U.S. Environmental Protection Agency, Office of Research and Development
Period: 7/74 to 6/75

All types of oils and oil products will be examined by various methods to determine chemical and physical properties in order to find useful oil identification techniques.

[SSIE No. AO-18091-2]

Status: The project has been completed.

Reports and Publications

SYSTEMS CHEMICAL ANALYSIS OF PETROLEUM POLLUTANTS

Kawahara, F.K., and Y.Y. Yang. 1976.
Analytical Chemistry 48(4):651-655.

Infrared spectrophotometric analysis with discriminant analysis was used to correctly characterize and identify 99% of several known and unknown petroleum samples. Unknown samples included weathered crude oils, heavy residual fuel oils, and asphalts. The same techniques are applicable to source identification of oil spills.

TRACE ORGANIC COMPONENTS AS FINGERPRINTS IN GAS CHROMATOGRAPHIC IDENTIFICATION OF SPILLED ASPHALTS

Kawahara, F.K. 1976.
Environmental Science and Technology 10(7).

Weak acids, mercaptans, and phenols are shown to be effective in fingerprinting heavy petroleum oils by capture detection-gas chromatography. Infrared and carbon-hydrogen analyses were also employed to verify the source of the asphalt.

Information Source: F.K. Kawahara, Environmental Protection Agency,
Environmental Monitoring and Support Laboratory,
Cincinnati, OH 45268

R-281-74 (renewal)
RESEARCH IN CHROMATOGRAPHY

Principal Investigators: Chesler, S.N., H.S. Hertz, B.H. Gump, and W.E. May
Performing Organization: U.S. Department of Commerce, National Bureau of Standards, Washington, D.C. 20234
Supporting Agency: U.S. Department of Commerce, National Bureau of Standards
Period: 7/75 to 6/76 Funds: $226,000

This contract provides for the development of chromatographic separation and analysis techniques for the quantative determination of trace levels of petroleum hydrocarbons, especially aromatic hydrocarbons. Analytical values for existing levels of crude oil pollution in the marine environment are also being established.

[SSIE No. ZBA-7006]

Status: Mass spectrometric identifications of hydrocarbons in samples from polluted sites have been made. Quantitative analysis of collected water and sediment samples has been completed and methods of tissue analysis are being developed. The "headspace sampling/coupled-column" technique for analysis of aromatic hydrocarbons has been applied in a quality assurance program relative to an oil spill in the Straits of Magellan.

Reports and Publications

TRACE HYDROCARBON ANALYSIS: THE NATIONAL BUREAU OF STANDARDS PRINCE WILLIAM SOUND/NORTHEASTERN GULF OF ALASKA BASELINE STUDY

Chesler, S.N., B.H. Gump, H.S. Hertz, W.E. May, S.M. Dyszel, and D.P. Enagonio. 1976.
National Bureau of Standards Technical Note, NBS TN-889, 66p.

The analytical method developed involves dynamic headspace sampling for volatile hydrocarbon components of the sample, followed by coupled-column liquid chromatography for the non-volatile components. Results of the application of this technique are presented and discussed.

DROP SAMPLER FOR OBTAINING FRESH AND SEA WATER SAMPLES FOR ORGANIC COMPOUND ANALYSIS

Gump, B.H., H.S. Hertz, W.E. May, S.N. Chesler, S.M. Dyszel, and D.P. Enagonio. 1975.
Analytical Chemistry 47(7):1223-1224.

A water sampling device that permits the analyst to obtain shallow and deeper water samples that are free from contamination by compounds on the surface is necessary. A water sampler is described which was designed to meet criteria proposed for the Integrated Global Ocean Station System.

CHROMATOGRAPHIC ANALYSIS OF HYDROCARBONS IN MARINE SEDIMENTS AND SEAWATER

May, W.E., S.N. Chesler, S.P. Cram, B.H. Gump, H.S. Hertz, D.P. Enagonio, and S.M. Dyszel. 1975.
Journal of Chromatographic Science 13:535-540.

The analytical method developed involves dynamic headspace sampling for volatile hydrocarbon components of the sample, followed by coupled-column liquid chromatography for the non-volatile components. Results of the application of this method to the analysis of samples from sites of known level hydrocarbon contamination are presented and discussed.

Information Source: U.S. Department of Commerce, National Bureau of Standards, Washington, D.C. 20234

R-273-75
ANALYTICAL METHODS FOR POLYNUCLEAR AROMATICS

Principal Investigator: Unknown
Performing Organization: Exxon Research and Engineering Company
Supporting Agency: American Petroleum Institute, No. 207-75
Period: Unknown

The object of this research is to examine the gas chromatographic-ultraviolet technique used in the Exxon Research and Engineering Laboratories for the determination of polynuclear aromatics at low levels in oils and in marine animal tissues.

Status: Work in 1974 resulted in the development of an analytical method applicable to the determination of low concentrations of specific PNA's in petroleum oils and animal tissues. Using this method, it is now possible to obtain data at the part-per-billion level on several PNA's in tissues of marine animals. Data are presently being collected on clams, oysters, crabs, flounder and other animals. Comparable samples are being obtained from pollution-free areas and from areas of known contamination when possible. Reports have been published in the open literature (ACS Petroleum Division).

Information Source: Environmental Research, Annual Status Report. API Publication No. 4275. February, 1976.

R-274-75 (renewal)
CHEMICAL ANALYSIS, IN-HOUSE

Principal Investigator: Unknown
Performing Organization: API member company laboratories
Supporting Agency: American Petroleum Institute, No. 204-75
Period: Unknown

Ongoing analytical studies are being carried out in API member company laboratories. The principal work performed in 1974 was by Exxon Research and Engineering Company in which four API reference oils being used in laboratory biological studies were characterized by mass spectrometric analysis.

[Environmental Research, Annual Status Report. API Publication No. 4275. February, 1976]

R-042-76
EVALUATION OF THE QUALITY OF URBAN STORMWATER RUNOFF

Principal Investigators: Bennett, E.R., and K.D. Linstedt
Performing Organization: University of Colorado, School of Engineering,
1200 University Ave., Boulder, CO 80302
Supporting Agency: U.S. Department of the Interior, Office of Water
Research and Technology, No. A-028-COLO
Period: 7/75 to 6/78

The characteristics and effects of stormwater drainage will be investigated. Stream areas with different types of development will be analyzed for flow, total and volatile solids, suspended matter, oily compounds, BOD, COD, nitrogen compounds, hardness, phosphorus, pH and temperature, sodium and chloride and heavy metals. Potential methods of pollution control for these discharges will be evaluated.

[SSIE No. GUY-358]

Status: No publications are available at the present time.

Information Source: E.R. Bennett, University of Colorado, Department
of Civil, Environmental, and Architectural Engineering,
Boulder, CO 80309

R-068-76
DEVELOPMENT OF AN X-RAY PHOTOGRAPHIC BENTHIC (BOTTOM) BASELINE METHOD

Principal Investigator: Howard, J.D.
Performing Organization: Skidaway Institute of Oceanography
Supporting Agency: American Petroleum Institute, No. 211-75
Period: Unknown (in progress)

The contract provides for the development of a semi-quantitative method for the rapid determination of the abundance of burrowing organisms in soft sediment, using an x-ray technique. Field work was performed during May-July, 1975, at the general site of the 1969 oil spill at West Falmouth, Massachusetts. X-ray analyses indicate no effect of the spill on the physical or biogenic sedimentary structure record. Zoological study results have not yet been received. A final report was scheduled to be submitted by spring, 1976.

[Environmental Research, Annual Status Report. API Publication No. 4275. February, 1976]

R-069-76
DEVELOPMENT OF ANALYTICAL METHODS

Principal Investigator: Warner, J.S.
Performing Organization: Battelle Columbus Laboratories, 505 King Ave., Columbus OH 43201
Supporting Agency: American Petroleum Institute, No. 212-75
Period: Unknown

The objective of this project is to continue to develop and validate methods for determining petroleum components in water, sediments, and marine animal tissues. Battelle is developing a new technique which uses a microreticular resin (TENAX) to trap hydrocarbons and other volatile organics, but reject water from the vapor phase. The hydrocarbons will be determined by gas chromatography.

[Environmental Research, Annual Status Report, API Publication No. 4275. February, 1976]

R-070-76
MARINE CHEMICAL PROCESSES

Principal Investigators: Wasik, S.P., and F.P. Schwarz
Performing Organization: U.S. Department of Commerce, National Bureau of Standards, Washington, D.C. 20234
Supporting Agency: U.S. Department of Commerce, National Bureau of Standards, No. 3163136; Environmental Protection Agency
Period: 7/75 to 6/76 Funds: Multiple support, $150,000

The objective of this project is to study the dissipation and biological utilization of pollutants in the marine environment. An electrolytic stripping technique has been developed for separating trace quantities of hydrocarbons from a seawater extract.

Status: Studies on the development of liquid crystal columns for hydrocarbon separation and analysis are continuing. Pilot studies have demonstrated that the electrolytic stripping technique provides a valable tool for the concentration of heavy hydrocarbon contaminants without need for introducing an extraction solvent, with its own trace contaminants, into the system. A study of the fluorescence spectra of molecules containing from one to five benzene rings in aqueous solution in concentrations ranging from saturation down to 0.1 ppb has been conducted, and a manuscript presenting the results of this study has been prepared.

Reports and Publications

DETERMINATION OF HYDROCARBONS IN SEA WATER USING AN ELECTROLYTIC STRIPPING CELL

Wasik, S.P. 1974.
Journal of Chromatographic Science 12:845.

[SSIE No. ZBA-7040]

B. OIL POLLUTION PREVENTION AND CONTROL

1. CONTAINMENT

R-071-76
DEVELOPMENT AND DEMONSTRATION OF NEW CONCEPTS TO CONTROL FLOATING OIL IN CURRENTS IN EXCESS OF 2.5 KNOTS (HIGH CURRENT BOOM DEVELOPMENT)

Principal Investigator: Ayers, R.R.
Performing Organization: Shell Development Company, Transportation Research and Engineering Department, P.O. Box 1280, Houston, TX 77001
Supporting Agency: U.S. Environmental Protection Agency, Oil and Hazardous Materials Spills Branch, No.68-03-0331
Period: Unknown (completed)

A boom capable of diverting oil spills toward shore in a 5.5 km/hr river or tidal current has been developed. The boom is made up of 2.5 m long, rigid sections similar in plan view to a floating dock module. Loss of No. 2 and No. 4 fuel oil at a velocity of 5.5 km/hr is less than 15% when the angle of the boom is 45 degrees to the shoreline. In contrast, conventional booms lose this amount at only 1.8 km/hr.

Reports and Publications

HIGH CURRENT CONTROL OF FLOATING OIL

Dorrler, J.S., R. Ayers, and D.C. Wooten. 1975.
Conference on Prevention and Control of Oil Pollution, San Francisco, 1975.

The Environmental Protection Agency awarded contracts to Ultrasystems Inc., Newport Beach, to design and develop a streamlined boom utilizing hydrofoil concepts for oil spill containment and to Shell Development Company, Houston, to develop a boom profile utilizing a perforated incline plate as a baffle upstream of a flow barrier. An analysis of the present oil containment problem is presented and a description of the progress made in developing each of the boom types is given.

A RIGID PERFORATED PLATE OIL BOOM FOR HIGH CURRENTS

Shell Development Company. 1976.
Final Report to U.S. Environmental Protection Agency, Contract No. 68-03-0331.

Summary not available.

Information Source: E.A. Milz, Manager, Shell Development Company
P.O. Box 1380, Houston, TX 77001

R-072-76
ENVIRONMENTAL POLLUTION CONTROL/DEVELOP OIL CONTAINMENT SYSTEM

Principal Investigator: Unknown
Performing Organization: Johns Manville Products Corporation, P.O. Box 159, Manville, NJ 08835
Supporting Agency: U.S. Department of Transportation, Coast Guard
Period: 7/75 to 6/76

Research aims are to develop a prototype lightweight oil containment system by constructing a barrier and to conduct field tests to evaluate its effectiveness.

[SSIE No. GZ-38337-3]

2. CLEANUP AND RECOVERY

R-073-76
FAST CURRENT OIL RESPONSE SYSTEM. PHASE II (ZERO-RELATIVE-VELOCITY (ZRV) BELT SKIMMER DEVELOPMENT)

Principal Investigator: Ayers, R.R.
Performing Organization: Shell Development Company, Transportation Research and Engineering Department, P.O. Box 1380, Houston, TX 77001
Supporting Agency: U.S. Department of Transportation, Coast Guard
Period: Unknown (in progress)

The contract provides for a further development program on Shell's ZRV sorbent belt skimming concept. Specific tasks include mathematical modeling, design and fabrication of a full-scale mockup of a belt and wringer/drive assembly, small-scale model tests of the vessel design in waves, oil collection performance and belt life test, final mock-up tests (at EPA's OHMSETT), and preliminary design of the prototype skimmer.

Status: The belt and wringer/drive mechanism has been built and tested in still water. The maximum recovery rate achieved is 333 l/min. per 30 cm of belt width at a velocity of 11 km/hr. Design improvements in progress should increase the recovery rate, even at higher velocities. Final tests of the improved design will be conducted at the EPA OHMSETT test tank in July, 1976. Phase II of the Final Report will be due September, 1976.

Reports and Publications

SYSTEM MODEL DEVELOPMENT OF TWO FAST CURRENT OIL REMOVAL SYSTEMS

Ard, R.W., R.R. Ayers, and R. Beach. 1976.
Offshore Technology Conference, 8th, Houston, 1976. Paper no. OTC-2691.

For summary see C-1368-76. p.51.

A ZERO RELATIVE-VELOCITY BELT SKIMMER (PHASE I)

Ayers, R.R. 1975.
Final report, USCG-D-116-75. 250p.

A new approach to high speed oil recovery incorporates the concept of zero relative velocity between a moving belt and the oil layer.

A sorbent belt made of Astroturf and Fueltron felt floats like a blanket on the water and absorbs oil. The belt is then withdrawn and the oil squeezed out. Full scale simulations indicate that further development is warranted.

Information Source: E.A. Milz, Manager, Shell Development Company,
P.O. Box 1380, Houston, TX 77001

R-074-76

A RESEARCH PROGRAM TO PROVIDE AN OIL SPILL SWEEP SKIMMER KIT FOR EMERGENCY USE ON VESSELS OF CONVENIENCE IN AND NEAR THE GULF OF ALASKA (SPILLED OIL CONTAINMENT KIT (SOCK) SKIMMER DEVELOPMENT)

Principal Investigator: Ayers, R.R.
Performing Organization: Shell Development Company, Transportation Research and Engineering Department, P.O. Box 1380, Houston, TX 77001
Supporting Agency: The Gulf of Alaska Clean-up Cooperative (GOACC), Anchorage, AK
Period: Unknown (in progress)

The program includes design, fabrication and testing necessary to produce a full-scale sweep skimmer for emergency use in the Gulf of Alaska. The result of this project is a Spilled Oil Containment Kit, with oil containment and removal equipment to be deployed on either side of a vessel of convenience, making the vessel an emergency sweep skimmer.

Status: Based on model tests to date the skimmer performance is expected to approach that of the state-of-the-art special purpose sweep skimmers. The major advantage of this kit will be a low capital outlay since no special purpose vessel must be built. Prototype tank tests with oil (September, 1976) and field tests of handling and durability (October, 1976) will conclude the project. The final report is due December, 1976.

Reports and Publications

SOCK--AN OIL SKIMMING KIT FOR VESSELS OF CONVENIENCE

Ayers, R.R., G.E. Walker, and A.V. Barnett.
To be presented at the 1977 Oil Spill Conference, March, 1977.

Information Source: E.A. Milz, Manager, Shell Development Company,
P.O. Box 1380, Houston, TX 77001

R-075-76
CONDUCT TEST IN AN OIL/ICE/WATER CONTROLLED ENVIRONMENT TEST FACILITY ON OIL RECOVERY DEVICES

Principal Investigator: Unknown
Performing Organization: Arctec Inc., Suite 225, Wilde Lake, Village Green, Columbia, MD 21045
Supporting Agency: U.S. Department of Transportation, Coast Guard
Period: 1/75 to 6/75 (est.)

The performing agency will 1) prepare for testing the facilities and devices for Phase 1; 2) assemble and checkout the instrumentation required to obtain data on oil/water recovery rate, oil recovery rate, recovery efficiency, throughput efficiency, oil characteristics, characteristics of recovered mixture and ice thickness, percent coverage and volume of oil absorbed into ice; 3) prepare a detailed test plant; and 4) conduct tests.

[MRIS Abstracts 12:#058308. 1975]

R-076-76
FEASIBILITY STUDY OF RESPONSE TECHNIQUES FOR SPILLS OF HAZARDOUS CHEMICALS THAT FLOAT ON WATER

Principal Investigator: Unknown
Performing Organization: MSA Research Corporation, Evans City, PA 16033
Supporting Agency: U.S. Department of Transportation, Coast Guard
Period: 7/75 to 6/76

The program will determine the feasibility of using vaporization rate reduction, vapor concentration reduction, and vapor flammability reduction techniques for cleanup of spills of hazardous chemicals that float on water.

[SSIE No. GZ-58551]

R-077-76
METHODS AND TECHNIQUES FOR RECOVERY AND DISPOSAL OF CRUDE OIL SPILLED UNDER ARCTIC ICE--SHORELINE PROTECTION AND CLEAN-UP

Principal Investigator: Unknown
Performing Organization: Montreal Engineering Company, Ltd., Montreal, Quebec, Canada
Supporting Agency: Canada Department of the Environment, No. OSS4-0224
Period: 7/75 to 6/76 Funds: $40,390

The study deals with methods and techniques of penetration of ice, recovery, transferral, separation and disposal of crude oil spilled under Arctic ice, containment, shoreline protection and cleanup.

[SSIE No. WDB-26]

R-078-76
OIL RECOVERY SYSTEM, CLEAN SWEEP MODEL R2003

Principal Investigator: Unknown
Performing Organization: Lockheed Missiles & Space Co., Santa Clara, CA 94088
Supporting Agency: U.S. Department of Transportation, Coast Guard
Period: 7/74 to 6/75 Funds: $21,153

No summary provided to SSIE.

[SSIE No. GZ-55993]

R-079-76
STUDY ENTRAINMENT AND EMULSIFICATION OF CRUDE OIL IN ARCTIC SEA ICE INCLUDING RECOVERY AND REMOVAL OF BALAENA BAY (ABBREV)

Principal Investigator: Unknown
Performing Organization: Norcor Engineering & Research Ltd., Yellowknife, Northwest Territories, Canada
Supporting Agency: Canada Department of the Environment, No. OSV4-0043
Period: 7/75 to 6/76 Funds: $54,070

No summary provided to SSIE.

[SSIE no. WDB-17]

3. RESTORATION

R-279-75 (renewal)
OILED-WATERFOWL REHABILITATION GRANT

Principal Investigator: Stanton, P.B.
Performing Organization: Wildlife Rehabilitation Center, Upton, MA
Supporting Agency: American Petroleum Institute, No. OS-12A
Period: Unknown

The program will perform research, consulting, and informational functions relating to the cleaning and rehabilitation of oiled birds.

Status: The grantee has compiled information on new compounds and techniques for cleaning and rehabilitating oiled birds, distributed copies of "Operation Rescue-Cleaning and Care of Oiled Waterfowl" and its associated bibliography, assisted in updating these publications, and acted as a consultant to industry and public and private organizations in establishing emergency reception, cleaning, and rehabilitation centers for oiled birds. In late 1975, Mr. Stanton's work included direction of cleanup operations following the "Corinthos" spill.

[Environmental Research, Annual Status Report. API Publication No. 4275. February, 1976]

R-080-76
SHORELINE PROTECTION AND RESTORATION

Principal Investigator: Unknown
Performing Organization: Woodward-Clyde Consultants, Suite 700, Two
Embarcadero Center, San Francisco, CA 94111
Supporting Agency: American Petroleum Institute, No. 305-75; Environmental Protection Agency
Period: Spring/76 to ?

The project is concerned with the evaluation through "real world" testing of selected surface treatment agents for the protection and restoration of shoreline and salt marsh areas.

[Environmental Research, Annual Status Report. API Publication No. 4275. February, 1976]

4. OIL TRANSFER AND TRANSPORT

R-308-74 (renewal)
EFFECTS OF CRUDE OIL TRANSFER AND UPSTREAM REFINERIES ON DELAWARE BAY

Principal Investigator: Biggs, R.B.
Performing Organization: University of Delaware, School of Marine Sciences, Lewes, DE 19958
Supporting Agency: U.S. National Science Foundation, Division of Environmental Sciences, No. ENV76-01193
Period: 9/75 to 12/75 Funds: $25,600

Lower Delaware Bay is the site of extensive transfer of crude oil from large tankers to small vessels; the threat a of massive oil spill continually exists. The objectives of this research are to develop a computer model which predicts the two-dimensional movement of an oil spill in Delaware Bay as a function of space and time, and to generate biological baseline data for Delaware Bay, in particular those areas most likely to be affected by an oil spill.

[SSIE No. GSV-7241]

R-081-76
POLLUTION PREVENTION FROM TANKSHIPS THROUGH DESIGN

Principal Investigator: Maniar, N.
Performing Organization: M. Rosenblatt & Son Inc., 350 Broadway, New York, NY 10013
Supporting Agency: U.S. Department of Transportation, Coast Guard
Period: 7/75 to 6/76

"Assemble facts, data and information to support regulatory action to reduce the probability of pollution incidents caused by tankers (ships and barges)."

[SSIE No. GZ-7389]

R-082-76
ARRANGEMENT AND STRUCTURAL STUDY OF A CLEAN BALLAST CRUDE CARRIER

Principal Investigator: Unknown
Performing Organization: City of Newport News, Newport News, VA 20230
Supporting Agency: Department of Commerce, Maritime Administration
Period: 6/75 to 12/75 (proposed)

The project will evaluate the economic impact of providing permanent clean ballast and light ship draft requirements through alternative design configurations for a VLCC, in accordance with IMCO's Annex I of the International Convention for Prevention of Pollution by Ships.

[MRIS Abstracts 12:#098267. 1975]

R-083-76
POLLUTION CONTROL AND PREVENTION-MERCHANT SHIPS

Principal Investigator: Unknown
Performing Organization: Exxon International Inc., 1251 Ave. of the Americas, New York, NY 10020
Supporting Agency: Department of Commerce, Maritime Administration
Period: 10/74 to 12/75 (est.)

Review washing crude oil cargo tanks and continue ocean sampling to assess background oil content.

[MRIS Abstracts 12:098271. 1975]

5. DESIGN AND ENGINEERING

R-084-76
COMBINED EFFECTS OF WAVES AND CURRENT ON PERFORMANCE OF OIL SLICK BARRIERS-OIL POLLUTION

Principal Investigator: Bently, F.
Performing Organization: Massachusetts Institute of Technology, Division of Sponsored Research, Cambridge, MA 02139
Supporting Agency: U.S. Department of Transportation, Coast Guard
Period: 7/75 to 6/76

Project goals include refining the barrier design, developing methods to evaluate barrier performance, and determining combined effect of waves and currents on the barrier.

[SSIE No. GZ-12116]

R-085-76
DESIGN AND FABRICATE OILY WATER SEPARATOR FOR USE AS A SUBSYSTEM OF AN OIL SPILL REMOVAL DEVICE

Principal Investigator: Unknown
Performing Organization: Foster Miller Associates, Inc., 135 2nd Ave., Waltham, MA 02154
Supporting Agency: U.S. Department of Transportation, Coast Guard
Period: 7/75 to 6/76

The separator will undergo various tests in order to identify problems resulting from the fabrication or assembly, evaluate the separation performance of the system, and evaluate and refine the automatic control features.

[SSIE No. GZ-58648]

R-086-76
DESIGN AND FABRICATION OF AN OPTICAL MULTICHANNEL SPECTRAL ANALYZER

Principal Investigator: Unknown
Performing Organization: Massachusetts Institute of Technology, Charles Stark Draper Lab, Cambridge, MA 02139
Supporting Agency: U.S. Department of Transportation, Office of the Secretary
Period: 7/75 to 6/76

The objective of this research is to develop an electro-optical multichannel spectral analyzer to be used as the receiver and signal processor in the Oil Spill Surveillance System.

[SSIE No. GZ-45770]

R-087-76
OIL RECOVERY MODULE

Principal Investigator: Unknown
Performing Organization: Marine Construction & Design Co., Seattle, WA 98199
Supporting Agency: U.S. Department of Transportation, Coast Guard
Period: 7/74 to 6/75 Funds: $21,853

"Includes engineering service on an as required basis for consulting in conjunction with Coast Guard testing program."

[SSIE No. GZ-58249]

6. WASTE TREATMENT AND DISPOSAL METHODS

R-146-74 (renewal)

FEASIBILITY STUDY FOR OIL WATER SEPARATION (COALESCING PLATES AND PACKS CONCEPT)

Principal Investigator: Unknown
Performing Organization: General Electric Co., 3198 Chestnut St., Philadelphia, PA 19101
Supporting Agency: U.S. Department of Transportation, Coast Guard
Period: 7/75 to 6/76

The feasibility of a unique concept for oil-water separation for use in various shipboard applications will be evaluated.

[SSIE No. GZ-38159]

R-156-74 (renewal)

FEASIBILITY STUDY FOR ULTRAFILTRATION CONCEPT FOR OIL WATER SEPARATION

Principal Investigator: Unknown
Performing Organization: Abcor Inc., 341 Vassar St., Cambridge, MA 02139
Supporting Agency: U.S. Department of Transportation, Coast Guard
Period: 7/75 to 6/76

The contractors will evaluate the feasibility of unique concepts for oil water separation for ultimate use in various shipboard applications.

[SSIE No. GZF-38-2]

R-088-76

EVALUATION OF OILS AND EXTRACTION PLANT TAILINGS POND WASTEWATER

Principal Investigator: Hodgson, G.W.
Performing Organization: University of Calgary, Environmental Science Center, T2N 1N4, Calgary, Alberta, Canada
Supporting Agency: Canada Department of the Environment, No. OSS5-0355
Period: 7/75 to 6/76 Funds: $51,565

No summary provided to SSIE.

[SSIE No. WDB-16]

Status: The project is expected to continue.

Reports and Publications

SUBSURFACE BIOPHYSIOCHEMICAL TRANSFORMATIONS OF SPILLED CRUDE OIL

Duffy, J.J., E. Peake, and M.F. Mohtadi. 1976.
The Environmental Effects of Oil and Salt Water Spills on Land, Banff, 1975. 48p.

WATER SOLUBLE HYDROCARBONS AND THEIR DETECTION

Peake, E., M.T. Strosher, M. Strosher, and G.W. Hodgson. 1976.
The Environmental Effects of Oil and Salt Water Spills on Land, Banff, 1975. 45p.

OIL AND GREASE ANALYSES OF DRILLING MUDS. AN INVESTIGATION OF THE RELIABILITY AND CONFIDENCE INTERVALS OF STANDARD WATER QUALITY ANALYSIS METHODS AS THEY APPLY TO THE DRILLING MUDS

Strosher, M., and J. Bogner. 1975.
Report to the Water Pollution Control Section, Environmental Protection Service. 16p.

POLYCYCLIC AROMATIC HYDROCARBONS IN LAKE WATER AND ASSOCIATED SEDIMENTS: ANALYTICAL DETERMINATION BY GAS CHROMATOGRAPHY-MASS SPECTROMETRY

Strosher, M.T., and G.W. Hodgson. 1975.
American Society for Testing and Materials,
Water Quality Parameters, ASTM STP 573. p.259-270.

DRILLING MUD AND SUMP FLUID ANALYSES. AN INVESTIGATION OF THE RELIABILITY AND CONFIDENCE INTERVALS OF STANDARD WATER QUALITY ANALYSIS METHODS AS THEY APPLY TO THE DRILLING FLUIDS

Strosher, M., D. Kosmak, and J. Bogner. 1974.
Environmental Sciences Centre (Kananaskis), University of Calgary. Report to the Working Group A of the Industry/ Government Research Program on Drilling Fluid Wastesunder Project No. PDS/B/01. 21p.

Information Source: C. Jackson, Environmental Sciences Centre, The University of Calgary, 2920 24 Ave., N.W., Calgary, Alberta, Canada T2N 1N4

R-089-76
REFINERY EFFLUENT WATER TREATMENT PLANT (CATGON FILTRASORB SYSTEM)

Principal Investigator: Prosche, M.
Performing Organization: Atlantic Richfield Co., 260 Broad St.,
Philadelphia, PA 19101
Supporting Agency: U.S. Environmental Protection Agency, Office of
Research and Development
Period: 7/74 to 6/75

The contract provides for the demonstration and evaluation of the effectiveness of an activated carbon system for periodic treatment of refinery wastewater and storm water runoff. The system is a parallel downflow granular activated carbon system which includes carbon regenerations designed to treat 4.2 mgd of wastewater and reduce the COD over 90% to an effluent value less than 40 mg/l.

[SSIE No. GMA-1502-2]

Status: The project is complete and three papers have been published.

Reports and Publications

ACTIVATED CARBON TREATMENT OF COMBINED STORM AND PROCESS WATERS

Author Unknown. 1976.
Open Forum on Management of Petroleum Refinery Wastewaters, University of Tulsa, January 26-29, 1976. (Sponsored by EPA-API-NPRA).

REFINERY EFFLUENT WATER TREATMENT PLANT USING ACTIVATED CARBON

Loop, G.C. 1975.
Report for 1971-1974, EPA/660/2-75-020. 102p.

Activated carbon is used to reduce the Chemical Oxygen Demand of a petroleum refinery's effluent water in Carson, California. In two years the plant processed 172 million gallons of water, operating at a cost of 40 cents per 1000 gallons of water treated. At average feed and effluent COD concentrations, the carbon was loaded at 0.26 pounds of COD per pound of carbon.

OPERATION AND PERFORMANCE OF A REFINERY WASTEWATER CARBON ADSORPTION PLANT

Prosche, M.A., G.C. Loop, and R.P. Strand. 1974.
Industrial Wastes Conference, 29th, West Lafayette, Indiana, May, 1974. Pt.1. p.255-261. (Purdue University Engineering Bulletin, Engineering Extension Series No. 145.)

The system selected consisted of impounding rain plus process water followed by activated carbon treatment to adsorb the COD material. The design and description of the plant are detailed.

Information Source: M.A. Prosche, Products Division, Atlantic Richfield Co., 1801 East Sepulveda Blvd., Carson, CA 90745

R-090-76

OIL-WATER SEPARATION BY INDUCED-AIR FLOTATION

Principal Investigator: Sylvester, N.D.
Performing Organization: University of Tulsa, School of Engineering and Physical Science, 600 S. College Ave., Tulsa, OK 74110
Supporting Agency: U.S. National Science Foundation, Division of Engineering
Peroid: 4/76 to 1/77 Funds: $21,350

This project is aimed at experimentally evaluating the mechanism and effects of several process variables on the oil-water separation efficiency of the induced-air flotation process. Phase I of the program will study the effect of the following variableson the efficiency of the process: oil types and concentration, emulsion droplet size and distribution, emulsion flow rate and/or residence time, and air flow rate and bubble size. Phase II will investigate the effect of chemical flocculation on the flotation efficiency of the same emulsions studied in Phase I.

[SSIE No. GSE-5640]

R-091-76

AIR AND WATER CONSERVATION RELATED TO PETROLEUM PROCESSING AND USE

Principal Investigator: Thomas, J.R.
Performing Organization: Chevron Research Co., P.O. Box 1627, Richmond, CA 94802
Supporting Agency: Standard Oil Co. of California
Period: 7/74 to 6/75

"Research, development, and process design pertinent to cleaner petroleum processing water effluent, cleaner petroleum processing effluent of the atmosphere, low sulfur fuels, and reduction of automovtive emissions."

[SSIE No. AQ-968-1]

Status: Chevron Research has continuing projects directed toward treating the effluent streams from refineries and other facilities as required to meet or exceed regulatory requirements. There have been no publications.

Information Source: A.L. Grassberg, Chevron Research Co., 576 Standard
Ave., Richmond, Ca 94802

R-092-76

EFFLUENT GUIDELINES FOR NON-PROCESS OPERATIONS

Principal Investigator: Tischler, L.F.
Performing Organization: Engineering Science, Inc.
Supporting Agency: American Petroleum Institute, No. 506-75
Period: Unknown

The wastewater characteristics of petroleum marketing terminals are being determined. The waste load of oils and greases discharged into existing effluent treatment systems and the efficiency of, and effluent quality from existing wastewater treatment units are being studied.

Status: Activity to date includes: critiques on which regional standards for terminals have been based; critique of background documents supporting oil and grease standards of the Interstate Sanitation Commission of New York, New Jersey, and Connecticut, and the stateof New Jersey; a survey of effluents from 45 petroleum terminals and a survey to expand the data base and develop statistically significant relationships among petroleum terminal effluents. A report was scheduled for early 1976 for input to the Environmental Protection Agency for use in developing terminal standards.

[Environmental Research, Annual Status Report. API Publication No. 4275. February, 1976]

7. PERSONNEL TRAINING AND EDUCATION

R-283-75 (renewal)
OIL SPILL CLEANUP TRAINING SCHOOL

Principal Investigator: Unknown
Performing Organization: Texas A & M University, College Station, TX 77843
Supporting Agency: American Petroleum Institute, No. 303-75
Period: Unknown

The contract provides for a comprehensive training course for cleaning up oil spills under a variety of conditions. Designed to be self-supporting and open to all parties, the school is now in full operation.

[Environmental Research, Annual Status Report. API Publication No. 4275. February, 1976]

R-284-75 (renewal)
TRAINING PROGRAM FOR PREVENTION OF OIL SPILLS

Principal Investigator: Unknown
Performing Organization: Educational Systems and Designs, Inc., National Photographic Laboratories
Supporting Agency: American Petroleum Institute, No. 306-75
Period: Unknown

The aim of the project is to develop a program which will motivate workers to prevent oil spills, and a training aid for the prevention of oil spills in barge loading and unloading operations.

Status: Completion of a film by Educational Systems and Designs to promote individual initiative in preventing spills was planned by June 1976.

National Photographic Laboratories (NPL) has developed a proposed outline for a barge loading/unloading training course. The API task force has approved the outline and instructed NPL to proceed with producing the course materials.

[Environmental Research, Annual Status Report. API Publication No. 4275. February, 1976]

8. CONTINGENCY PLANNING

R-093-76
DEVELOP NATIONAL POLLUTION RESPONSE CENTER HAZARDOUS MATERIALS INFORMATION SYSTEM (CHRIS)

Principal Investigator: Unknown
Performing Organization: Arthur D. Little, Inc., 25 Acorn Ave.,
Cambridge, MA 02142
Supporting Agency: U.S. Department of Transportation, Coast Guard
Period: 7/75 to 6/76

The contract provides for the development of a computerized information system to provide pertinent information for routine and emergency control of dangerous chemical shipments. The information system will be incorporated as a part of the National Pollution Response Center as delineated in the National Multiagency oil and hazardous materials contingency plan.

[SSIE No. GZ-7411]

C. EFFECTS OF OIL POLLUTION

1. BIOLOGICAL EFFECTS

R-088-74 (renewal)
FUNDAMENTAL ANALYSIS TO ENABLE DETERMINING EFFECTS OF OIL POLLUTION

Principal Investigators: Glynn, P.W., C. Birkeland, A.A. Reimer, and J.R. Young
Performing Organization: U.S. Environmental Protection Agency, 401 M St., S.W., Washington, D.C. 20460
Supporting Agency: Smithsonian Institution Tropical Research Institute, No. 14-12-874
Period: 7/74 to 6/75 Funds: Multiple Support

In late 1968, a tanker broke up two to three miles from the STRI marine laboratory at Galeta Island. Since little quantitative data were available on the organisms of the reefs and mangroves nearby, the "biological costs" of the oil pollution could not be assessed. STRI proposes to establish the necessary baselines and to explore several natural agents of oil pollution abatement.

[SSIE No. GTA-64-3]

Status: The final report has been accepted by EPA and is in the process of being published.

Reports and Publications

EFFECTS OF CRUDE OIL ON THE FEEDING BEHAVIOR OF THE ZOOANTHID *PALYTHOA VARIABILIS*

Reimer, A.A. 1975.
Environmental Physiology and Biochemistry 5(4):258-266.

Marine Diesel and Bunker-C oils can elicit feeding behavior and eventually ingestion in the zooanthid. The ability of the polyps to discriminate between inert and chemically active particles is decreased for three to five days after exposure to oil. For several days following exposure, oil is retained in the coelenteron and periodically released as tiny droplets.

EFFECTS OF CRUDE OIL ON CORALS

Reimer, A.A. 1975.
Marine Pollution Bulletin 6(3):39-43.

Four species of Panamanian corals were exposed to marine diesel and bunker oil. The oils may cause delayed death and definitely alter feeding and metabolic behavior at sublethal concentrations.

Information Source: A.A. Reimer, Pennsylvania State University,
208 Life Sciences I, University Park, PA 16802

R-231-74
SURVEY OF SUBLETHAL EFFECTS ON BIOTA OF CHRONIC NATURAL EXPOSURE TO OIL

Principal Investigator: Straughan, D.
Performing Organization: Univeristy of Southern California, Allan Hancock Foundation, University Park, Los Angeles, CA 90007
Supporting Agency: American Petroleum Institute
Period: Unknown

California beach areas subject to long term oil exposure will be surveyed for growth irregularities and abnormalities of the biota. Unpolluted beach areas will be surveyed and used as controls.

[SSIE No. PAP-76]

Status: All experimental work was completed in 1974. A final report was scheduled to be released in spring, 1976. The following conclusions have resulted from the study: areas of Coal Oil Point containing high levels of sedimentary petroleum hydrocarbons are inhabited by marine animals; the occurrence of such hydrocarbons in this environment has been found to be extremely variable, as has that of biogenic hydrocarbons; no malformations were observed in organisms at Coal Oil Point; no relationship was found between levels of petroleum hydrocarbons in sediments and biomass or abundance, presence, or absence of any group of organisms; no adverse, sublethal effects were found in abalones, sea urchins, and mussels at Coal Oil Point.

(A list of publications which have resulted from this research appear in Oil Spill and Oil Pollution Reports, November'74-February'75. p.213)

Information Source: Environmental Research, Annual Status Report.
API Publication No. 4275. February, 1976

R-255-74 (renewal)
BIOLOGICAL FIELD STUDIES OF EFFECTS OF OIL ON MARINE ORGANISMS

Principal Investigator: Anderson, J.W., and J.M. Neff
Performing Organization: Texas A & M Unversity System, Center for
Marine Resources, College Station, TX 77843
Supporting Agency: American Petroleum Institute, No. 206-75
Period: Unknown (in progress)

The research applies technology and data gained in laboratory models to the natural marine environment. Oysters, clams, marine worms, shrimp and fish are being exposed and studied for such effects as mortality, growth, inhibition and enhancement, altered physiology, carcinogenesis, and reproduction. Any such effects will be related to appropriate measurements of hydrocarbons in organisms' tissues and in the environment.

[Environmental Research, Annual Status Report, API Publication No. 4275. February, 1976]

Reports and Publications

EFFECTS OF PETROLEUM HYDROCARBONS ON THE GROWTH OF MARINE ORGANISMS (in press)

Anderson, J.W. 1976.
Petroleum Hydrocarbons in the Marine Environment, International Council for the Exploration of the Sea Workshop, No. G3. 19p.

Summary not available.

EFFECTS OF PETROLEUM HYDROCARBONS ON THE RATE OF HEART BEAT AND HATCHING SUCCESS OF ESTUARINE FISH EMBRYOS (in press)

Anderson, J.W., D.B. Dixit, G.S. Ward, and R.S. Foster. 1976.
Pollution and Physiology of Marine Organisms, II. F.J. and W.B. Vernberg (eds.). New York, Academic Press.

Summary not available.

ACCUMULATION AND RELEASE OF PETROLEUM HYDROCARBONS BY EDIBLE MARINE ANIMALS

Anderson, J.W., and J.M. Neff. 1976.
Recent Advances in the Assessment of the Health Effects of Environmental Pollution, Volume III. Luxembourg, Commission European Communities, 1976. p.1461-1469. Proceedings.

Summary not available.

THE EFFECTS OF OIL ON ESTUARINE ANIMALS: TOXICITY, UPTAKE AND DEPURATION, RESPIRATION

Anderson, J.W., J.M. Neff, B.A. Cox, H.E. Tatem, and G.M. Hightower. 1974.
Pollution and Physiology of Marine Organisms. F.J. and W.B. Verberg (eds.)s New York, Academic Press, 1974. p.285-310.

Laboratory studies on the short-term toxicity, rates of accumulation and release, and metabolic response to two crude and two refined oils were conducted. Three organisms were used. Water-soluble fractions of the refined oils were the most toxic. Rates of accumulation were rapid, but the hydrocarbons were only retained briefly. Metabolic responses varied.

SUBLETHAL EFFECTS OF OIL, HEAVY METALS AND PCBS ON MARINE ORGANISMS

Anderson, J.W., J.M. Neff, and S.R. Petrocelli. 1974.
Survival in Toxic Environments. M.A.Q. Khan, and J.P. Bederka, Jr. (eds.). New York, Academic Press, 1974. p.83-121

A review is presented of the research conducted on the sublethal effects of three major pollutant classes commonly found in estuarine environments. Results indicated that levels of petroleum hydrocarbons in animal tissues may act to temporarily alter the regulatory ability of test individuals; the class of hydrocarbons accumulated to the greatest extent and retained the longest in animals being the naphthalenes.

PETROLEUM HYDROCARBONS AND OYSTER RESOURCES OF GALVESTON BAY, TEXAS

Anderson, R.D. 1975.
Conference on Prevention and Control of Oil Pollution, San Francisco, 1975. p.541-548.

Significant amounts of petroleum-derived hydrocarbons were detected in oysters collected at the lower end of the Houston Ship Canal. Once transferred to oil-free seawater, oysters released saturated chains and most aromatic fractions rapidly with depuration to less than 0.1 ppm within 52 days. Transfer of oysters may improve the overall quality of this shellfish resource.

EFFECTS OF SALINITY AND SELECTED PETROLEUM HYDROCARBONS ON THE OSMOTIC AND CHLORIDE REGULATION OF THE AMERICAN OYSTER, *CRASSOSTREA VIRGINICA*

Anderson, R.D., and J.W. Anderson. 1975.
Physiological Zoology 48(4):420-430.

Oysters exposed to No. 2 fuel oil were unable to osmotically adjust at the same rate as the control group when salinity concentrations were altered. Those exposed to South Louisiana crude oil, however, responded to salinity changes much like the controls. After 10 days in oil-free seawater, all oysters exposed to either No. 2 fuel oil or South Louisiana crude oil reached equilibrium with the respective media.

SOME EFFECTS OF NO. 2 FUEL OIL ON THE BROWN SHRIMP *PENAEUS AZTECUS*

Cox, B.A. and L.W. Anderson. 1973.
American Zoologist 13(4):262. Abstracts.

The uptake and depuration of water-soluble fractions of No. 2 fuel oil by three size groups of brown shrimp were examined. Total hydrocarbons present were determined by infrared spectrophotometry. When shrimp of two size classes were exposed to 1.3 ppm No. 2 fuel oil fractions for 20 hours, maximum uptake for both classes occurred within the first exposure hour, and depuration began during the 20 exposure hours. Larger shrimp were found to absorb four times as much of the oil fractions as did smaller shrimp, but depuration occurred more rapidly in the large size group.

FATE AND EFFECT OF NAPHTHALENES IN CONTROLLED ECOSYSTEM ENCLOSURES

Lee, R.F., and J.W. Anderson. 1976.
Submitted to Bulletin of Marine Sciences.

Summary not available.

OIL POLLUTION AND SHELLFISH

Neff, J.M. 1974.
National Shellfish Sanitation Workshop, 8th. D.S. Walt(ed.).
National Shellfish Safety Program. 158p.

Summary not available.

ULTRAVIOLET SPECTROPHOTOMETRIC METHOD FOR THE DETERMINATION OF NAPHTHALENE AND ALKYLNAPHTHALENES IN THE TISSUES OF OIL-CONTAMINATED MARINE ANIMALS

Neff, J.M., and J.W. Anderson. 1975.
Bulletin of Environmental Contamination and Toxicology 14(1):122-128.

The article describes a direct UV spectrophotometric method for the semiquantitative determination of naphthalene, methylnaphthalenes.

and dimethylnaphthalenes in seawater and in marine animal tissues. In past hydrocarbon accumulation and retention studies as little as 0.1 ppm of naphthalene and alkylnaphthalenes have been detected without difficulty in marine animal tissues. The detection limits in seawater are in the range of 0.01 to 0.05 ppm.

ACCUMULATION AND RELEASE OF FUEL OIL DERIVED DIAROMATIC HYDROCARBONS BY THE POLYCHAETE, *NEANTHES ARENACEODENTATA*

Rossi, S.S., and J.W. Anderson. (Submitted for API reveiw)

Summary not available.

TOXICITY OF WATER-SOLUBLE FRACTIONS OF NO. 2 FUEL OIL AND SOUTH LOUISIANA CRUDE OIL TO SELECTED STAGES IN THE LIFE HISTORY OF THE POLYCHAETE, *NEANTHES ARENACEODENTATA*

Rossi, S.S., and J.W. Anderson. (Submitted for API review)

Summary not available.

TOXICITY OF WATER-SOLUBLE FRACTIONS OF FOUR TEST OILS FOR THE POLYCHAETOUS ANNELIDS, *NEANTHES ARENACEODENTATA* AND *CAPITELLA CAPITATA*

Rossi, S.S., J.W. Anderson, and G.S. Ward. 1976.
Environmental Pollution 10(1):9-18.

Of the water soluble fractions of the four oils tested, the two refined oils were more toxic than the two crude oils. The refined oils contained more diaromatic compounds (naphthalenes) which is the probable reason for their increased toxicity. Although the two species of annelids differed slightly in sensitivity, they were similar to fish and crustaceans in their reaction to these four oils.

THE TOXICITY OF FOUR OILS TO *PALAEMONETES PUGIO* (HOLTHUIS) IN RELATION TO UPTAKE AND RETENTION OF SPECIFIC PETROLEUM HYDROCARBONS

Tatem, H.E., and J.W. Anderson. 1973.
American Zoologist 13(4):261. Abstracts.

Results are given from studies measuring the effects of water soluble fractions (WSFs) of Southern Louisiana, Kuwait, No. 2 Fuel, and Bunker C oils on *P. Pugio*. It was found that the more toxic oils contained higher proportions of naphthalene, methylnaphthalene and dimethylnaphthalene which are rapidly accumulated by *Palaemonetes* but readily released if the initial exposure is not lethal.

Dissertations

EFFECTS OF PETROLEUM HYDROCARBONS ON THE PHYSIOLOGY OF THE AMERICAN OYSTER, CRASSOSTREA VIRGINICA GMELIN

Anderson, R.D. 1973.
Submitted to the Graduate College of Texas A & M Univeristy.

Summary not available.

RESPONSES OF THE MARINE CRUSTACEANS MYSIDOPSIS ALMYRA BOWMAN, PENAEUS AZTECUS IVES, AND PENAEUS SETIFERUS (LINN.) TO PETROLEUM HYDROCARBONS

Cox, B.A. 1974.
Submitted to the Graduate College of Texas A & M University.

Toxicity studies showed the refined No. 2 fuel oil and Venezuelan Bunker C oil to be six times more toxic to mysids than either Southern Louisiana crude or Kuwait crude oil. Naphthalene compounds in the No. 2 fuel oil were found to be responsible for most of the toxicity. White shrimp (P. setiferus) and brown shrimp (P. aztecus) were less sensitive to water-soluble fractions (WSF) of No. 2 fuel oil than the mysid (M. almyra). Growth rate, molting frequency, and respiratory rate in these animals were not altered by the WSF of No. 2 fuel oil or crude oil.

INTERACTIONS BETWEEN PETROLEUM HYDROCARBONS AND THE POLYCHAETOUS ANNELID, NEANTHES ARENACEODENTATA: EFFECTS ON GROWTH AND REPRRODUCTION: FATE OF DIAROMATIC HYDROCARBONS ACCUMULATED FROM SOLUTION OR SEDIMENTS

Rossi, S.S. 1976.
Submitted to the Graduate College of Texas A & M University.

Summary not available.

THE TOXICITY AND PHYSIOLOGICAL EFFECTS OF OIL AND PETROLEUM HYDROCARBONS ON ESTUARINE GRASS SHRIMP PALAEMONETES PUGIO HOLTHUIS

Tatem, H.E. 1975.
Submitted to the Graduate College of Texas A & M University.

Summary not available.

Presentations

EFFECTS OF PETROLEUM HYDROCARBONS ON THE GROWTH AND DEVELOPMENT OF MARINE CRUSTACEANS AND POLYCHAETES

Anderson, J.W., J.M. Neff, H.E. Tatem, B.A. Cox, S.S. Rossi and R.L. Laughlin. 1976.
American Society of Zoologists, Annual Meeting, New Orleans, May 31-June 4, 1976.
Workshop: Effects of Environmental Pollutants on Developing Invertebrates

R-295-75
WEST FALMOUTH FOLLOW-UP STUDIES

Principal Investigator: Michael, A.
Performing Organization: Marine Biological Laboratory, Woods Hole, MA 02543
Supporting Agency: American Petroleum Institute, No. OS-20L
Period: 7/74 to 12/75

A study is being conducted to determine the state of recovery of the entire West Falmouth area affected by the 1969 spill. Results have indicated that the benthic fauna of the area have substantially recovered, although the number of species in the Wild Harbor marsh is lower than at a control marsh. The offshore area is closer to total recovery than either the marsh or boat basin.

Status: In mid-to late 1974, the contractor found that his control stations, not previously affected by the oil spill, were decreasing in bottom animal life. Subsequent observations indicated these changes to be unrelated to the oil spill, that the exposed marsh is indistinguishable from the control, and that only an acre in the boat basin remains affected. Field studies were completed by the end of 1975 and the final project report will follow.

Information Source: Environmental Research, Annual Status Report. API Publication No. 4275. February, 1976.

R-052-76
EFFECT OF DEGRADED OIL (MICROBIAL) UPON THE FERTILIZATION AND DEVELOPMENT OF SEA URCHIN EGGS

Principal Investigator: Stormer, F.C.
Performing Organization: National Institute of Health, Oslo, Norway
Supporting Agency: Unknown
Period: Unknown

Part of the research project will be performed at Stazione Zoologica Napoli, Italy.

[American Society for Microbiology, Aquatic Microbiology Newsletter 14(3):27. 1975.]

Reports and Publications

MICROBIAL DEGRADATION OF EKOFISK OIL IN SEAWATER BY SACCHAROMYCOPSIS LIPOLYTICA

Stormer, F.C., and A. Vinsjansen. 1976.
Ambio 5(3):141-142.

The effect of pH and temperature on the acid production during degradation of Ekofisk oil by the yeast S. lipolytica in seawater in the presence of nutrients is described. Final results indicated that the biodegraded sample was dispersed. Most of the organic acids produced have a hydrophobic and hydrophilic part which makes them useful in dissolving oil into microdroplets.

Information Source: F.C. Stormer, National Institute of Health, Oslo, Norway

R-094-76
EFFECTS OF PETROLEUM HYDROCARBONS AND DRILLING MUD ON CORAL REEFS

Principal Investigator: Anderson, J.W.
Performing Organization: Texas A & M University, Center for Marine Resources, College Station, TX 77843
Supporting Agency: American Petroleum Institute, No. 215-75
Period: Unknown

Among the questions raised in this study are whether corals concentrate hydrocarbons in their tissues, whether they cleanse themselves of drilling mud, how much sedimentation by drilling mud they can withstand, whether growth rate is affected and what is the toxicity of oil to various reef fish. Research includes placing plastic tents over entire coral reef communities and then introducing oil beneath them.

[Environmental Research, Annual Status Report. API Publication No. 4275, February, 1976.]

Status: A manuscript is being prepared on information gathered from the first and second year investigations. A paper entitled, Behavioral Responses of Hermatypic Corals to Drill Mud and Drill Mud Components, will be submitted for presentation at the 1977 Oil Spill Conference.

Information Source: J.W. Anderson, Battelle Pacific Northwest Division, Marine Research Laboratory, Route 2, Box 140, Sequim, WA 98382

R-095-76

MARSHLAND RECOVERY STUDIES

Principal Investigator: Bender, M.E.
Performing Organization: Virginia Institute of Marine Science,
Gloucester Point, VA 23062
Supporting Agency: American Petroleum Institute, No. 210-75
Period: Unknown

The study will determine the acute environmental effects of fresh and aged crude oils on an estuarine marshland. A coastal tidal-marsh estuarine ecosystem was modified by erection by oil containment barriers so as to provide mini-ecosystem oil test sites and controls. Spills of both fresh and artificially-aged South Louisiana crude were made, and results to date indicate that the initial toxicity of the aged crude was greater than that of fresh crude. The aged crude showed an initial kill of all caged fish and substantial marsh grass kills. Subsequent observations with caged fish indicate the toxicity of the aged crude to be of short duration.

[Environmental Research, Annual Status Report, API Publication No. 4275. February, 1976]

R-096-76

EVALUATION OF POTENTIAL TOXICITY OF CRUDE OIL TO LARVAL LOBSTERS

Principal Investigator: Forns, J.R.
Performing Organization: Westinghouse Ocean Research Laboratory,
San Diego, CA
Supporting Agency: American Petroleum Institute, No. 125-76
Period: Unknown

This study is designed to determine whether larval lobsters are vulnerable to an oil spill during their early developmental stages. Laboratory investigations demonstrated good larval survival in most instances; however, some subtle effects of oil exposure were observed. Final preparation and release of the project report was expected during the first quarter of 1976. Phase II of this study is planned for 1976.

[Environmental Research, Annual Status Report. API Publication No. 4275. February, 1976]

R-097-76
BIOLOGICAL EFFECTS OF PELAGIC OIL

Principal Investigators: Gebelein, C.D., and N.E. Maynard
Performing Organization: Bermuda Biology Station
Supporting Agency: American Petroleum Institute, No. 209-75
Period: 6/74 to 8/76

The effects of pelagic oil (tar balls) on the health and population of intertidal marine organisms are being determined in this study. Parameters being examined include species composition, abundance and diversity, zonation, hydrocarbon analyses of animal tissues and algal biomass, and preliminary analyses of tar globules and the effects of weathering.

Status: The following conclusions resulted from the first year's work: there is no measurable effect of tar influx on the number of organisms of any species inhabiting the intertidal zone; there is no relationship of tar influx to their reproductive patterns; and their size frequency is unaffected by either tar influx or tar coverage. Conclusions concerning the content of hydrocarbons in tissues of species as a result of tar pollution are not yet definitive. Additional research to be conducted in the second year includes investigation of organisms which inhabit the splash zone and tide pools along the shoreline where tar accumulates.

[Environmental Research, Annual Status Report. API Publications No. 4275. February, 1976]

R-098-76
CONTROLLED ECOSYSTEM POLLUTION EXPERIMENT (CEPEX)-ZOOPLANKTON POPULATION ASSESSMENT

Principal Investigator: Grice, G.D.
Performing Organization: Woods Hole Oceanographic Institution, Main St., Woods Hole, MA 02543
Supporting Agency: U.S. National Science Foundation, Division of Ocean Sciences
Period: 3/76 to 11/76 Funds: $34,900

In CEPEX, scientists from the United States, United Kingdom, and Canada are studying the effects of specific pollutants on oceanic communities. In the proposed research, zooplankton contained in large plastic cylinders are subjected to low-level and long term exposure to petroleum, polychlorinated biphenyls and heavy metals. The results will permit assessment of the impact of known levels of pollutants on zooplankton species, occurrence, abundance and life history.

[SSIE No. GSN-1507-2]

R-099-76
CHRONIC EFFECTS OF INGESTED PETROLEUM IN MARINE BIRDS

Principal Investigators: Holmes, W.N., J. Cronshaw, and A. Crocker
Performing Organization: University of California, Santa Barbara,
Santa Barbara, CA 93106
Supporting Agency: U.S. Department of the Interior
Period: 1/76 to 1/80 Funds: $187,165

The contract provides for the comprehensive study of the effects of ingested crude oil on the health of marine birds. Adult mallard ducks adapted to seawater are being fed diets containing known concentrations of crude oils from various geographical locations. Factors being monitored include body weight, amounts of food and oil consumed daily, hormonal status of the adrenal glands, and environmental stress. The data are compared with those from control groups fed uncontaminated food.

Results: The team's study over the past four years has demonstrated that when crude oil is ingested by seawater-adapted ducklings the uptake of water and salts from the intestine is impaired. As a result, the physiological mechanisms that balance the intake and excretion of water and salts in these birds are disturbed.

Information Source: W.N. Holmes, University of California, Santa
Barbara, Santa Barbara, CA 93106

R-100-76
PHYSIOLOGICAL EFFECTS OF CONTAMINANTS-EFFECT OF ALTERATIONS IN THE NATURAL ENVIRONMENT

Principal Investigator: Malins, D.C.
Performing Organization: U.S. Department of Commerce, Environmental
Conservation Division, 2725 Montlake Blvd.E
Seattle, WA 98112
Supporting Agency: U.S. Department of Commerce, National Oceanic and
Atmospheric Administration, National Marine Fisheries
Service, No. FB 1600/8 818 A4
Period: 7/74 to ? (in progress)

The aim of the project is to determine the extent and effects of natural and man-induced contaminants and alterations on the distribution, abundance, and function of aquatic organisms in the lower Columbia River and estuary and in northern Puget Sound. Temperature, petroleum hydrocarbons, nitrogen gas supersaturation, maintenance dredging, and offshore disposal of dredged materials are parameters currently under investigation.

[SSIE No. 2BP-945]

Reports and Publications

METABOLISM OF AROMATIC HYDROCARBONS IN COHO SALMON (ONCORHYNCHUS KISUTCH)

Roubal, W.T., T.K. Collier, and D.C. Malins. 1976.
Federal Proceedings 35(7):1710.

Benzene-U-^{14}C, naphthalene-1-^{14}C, and anthracene-9-^{14}C were administered to juvenile coho salmon in the food and by intraperitoneal injection. After each exposure, ^{14}C in key organs (i.e. liver, brain) increased with time in the order anthracene> naphthalene>benzene. After intraperitoneal injection, the highest percentages of aromatic metabolites occurred in the gall bladder and significant amounts were found in the liver, brain, and muscle. Data suggests that aromatic metabolites are broadly distributed in fish exposed to polynuclear aromatic hydrocarbons and consideration of these products should be included when quantifying aromatic hydrocarbons in marine fish.

Information Source: D.C. Malins, U.S. Department of Commerce, Environmental Conservation Division, 2725 Montlake Blvd. E.
Seattle, WA 98112

R-101-76
BACTERIAL CHEMOTAXIS AND MARINE POLLUTION

Principal Investigators: Mitchell, R., and G. McKay
Performing Organization: Harvard University, Division of Engineering and Applied Physics, Cambridge, MA 02138
Supporting Agency: Department of the Navy, Office of Naval Research
Period: 6/69 to ?

Recent observations indicate that crude oil possesses some limited solubility chemoreception in seawater and may have an inhibitory effect on chemoreception in marine bacteria. The effects of chemical pollutants in the sea on chemoreception in microorganisms will be studied. Work will encompass 1) the ecological significance of chemotaxis, and 2) the effects of pollutants on chemoreception.

Results: The addition of pollutants to bacterial suspensions at concentrations of 10^{-4} M significantly inhibits chemotaxis. Chlorinated hydrocarbons, petroleum hydrocarbons, alcohols, and metal salts all inhibited chemoreception. These concentrations are not lethal and the chemotactic response can be regained. Chlorinated hydrocarbons have a greater effect than petroleum hydrocarbons on chemotaxis.

Reports and Publications

EFFECT OF CHEMICAL POLLUTANTS ON CHEMOTAXIS
Walsh, F., and R. Mitchell

[MRIS Abstracts 12:#044221. 1976]

R-102-76
NEOPLASIA IN MARINE MOLLUSKS

Principal Investigator: Saila, S.B.
Performing Organization: University of Rhode Island, Kingston, RI 02881
Supporting Agency: American Petroleum Institute, No. 221-75
Period: 10/75 to ?

Clams are to be selected from at least a dozen locations along the New England coastline, which represent different types of exposure to contaminants, to determine the etiology of any neoplasia encountered.

[Environmental Research, Annual Status Report. API Publication No. 4275. February, 1976]

R-103-76
SEAGRASS COMMUNITY PROCESSES IN COASTAL ZONES OF THE SEMITROPICS AND TROPICS

Principal Investigator: Thorhaug, D.A.
Performing Organization: University of Miami, Rosenstiel School of Marine and Atmospheric Science, 4600 Rickenbacker Causeway, Miami, FL 33124
Supporting Agency: U.S. Energy Research and Development Administration, Biomedical and Environmental Research Division
Period: 9/75 to 8/76 Funds: $47,185

The investigators are studying key problems in the Thalassia (seagrass) ecosystem process which will lead to an understanding of and predictive model for management of these marine benthic nearshore communities. Problem areas to be investigated include productivity, nutrient and trace metal cycling, and the effect of pollutants, such as oil, copper, chlorine and temperature, and energy flow.

Status: The project is continuing. There have been no published results to date.

[SSIE No. GPE-5266-Z]

R-104-76

RESPONSE TO CRUDE OIL OF SELECTED MICROBIAL POPULATIONS IN A TIDAL MARSH

Principal Investigator: Unknown
Performing Organization: Virginia Institute of Marine Science,
Gloucester Point, VA 23062
Supporting Agency: American Petroleum Institute, No. 203-75
Period: 5/75 to ?

The research deals with measuring the effects of spilled crude oil upon natural tidal marsh microbial populations which use hydrocarbons and populations which are significant in the mineralization of organic biopolymers (cellulose, chitin, etc.). This study is a part of the Marshland Recovery Program (210-75) conducted by VIMS.

[Environmental Research, Annual Status Report. API Publication No. 4275. February, 1976]

2. GENERAL EFFECTS OF OIL POLLUTION

R-105-76

LONG-TERM EFFECTS OF HYDROCARBONS ON SELECTED ECOSYSTEMS AND ASSOCIATED ORGANISMS

Principal Investigators: Gibson, C.I., J.R. Vanderhorst, and R.M. Bean
Performing Organization: Battelle Memorial Institute, P.O. Box 999, Richland, WA 99352
Supporting Agency: U.S. Energy Research and Development Administration Biomedical and Environmental Research Division, Contract E(45-1)1830
Period: 7/75 to 6/76

This program will examine the laboratory response of populations and benthic communities to concentrations of single hydrocarbon compounds and aqueous phase petroleum, and the in situ response of coastal communities to sediment-bound petroleum.

For a list of the current programs and publications being conducted by Battelle, see "Oil Spill and Oil Pollution Reports", November '75-January '76, p.252-257.

[SSIE No. ZPE-11367]

R-106-76

COMPILATION OF COLD-CLIMATE OIL-SPILL RESEARCH AND TECHNOLOGY PERTAINING TO ALASKAN SHORELINES

Principal Investigator: Mckendrick, J.D.
Performing Organization: Univeristy of Alaska, Institute of Agricultural Sciences, Box E, Palmer, AL 99645
Supporting Agency: U.S. Environmental Protection Agency, National Environmental Research Center
Period: 7/74 to 6/75 Funds: $115,000

Project objectives were to assess the adequacy of available methods and techniques for preventing damage from oil spills to coastal and inland shorelines and for restoring spill damaged areas to as near original conditions as possible. The field of investigation included both Alaskan and Canadian territories. These methods will be documented in the form of a prevention, cleanup and restoration manual for potential spill areas.

[SSIE No. GMA-2364]

D. EFFECTS OF OIL PROSPECTING AND PRODUCTION

1. BIOLOGICAL EFFECTS

R-056-76

EFFECT OF REFINERY EFFLUENTS ON AQUATIC LIFE

Principal Invesitgator: Buikema, A., J. Cairns, and K. Dickson
Department: Biology
Performing Organization: Virginia Polytechnical Institute and State University, School of Arts and Sciences, Burruss Hall, Blacksburg, VA 24061
Supporting Agency: American Petroleum Institute
Period: 7/74 to 12/75

A number of freshwater and marine organisms will be surveyed to discover a biological monitor for refinery effluents. The object is to develop a simple, compact, inexpensive technique to be used by nonbiologists. Freshwater organisms have been surveyed; marine work began in early 1975.

[SSIE No. PAP-98]

Status: Bioassays using the _Daphnia pulex_ methodology for toxicity testing of refinery effluents, developed during the fresh-water phase of the project, were conducted over a range of temperatures, water hardnesses, pH's, photoperiods and culture conditions. The relationships between _Daphnia_ bioassays and fish bioassays and the effect of specific chemical contaminants found in refinery wastewaters were determined.

In the salt water phase, an array of estuarine invertebrates and fish has been examined and tested for use in bioassays of refinery effluents. A preferred animal has been selected and test methodology is being designed. A supplemental study has been initiated to examine the feasibility of using selected enzyme systems for screening effluent wastes in fresh and brackish water environments.

Reports and Publications

A SCREENING BIOASSAY USING _DAPHNIA PULEX_ FOR REFINERY WASTES DISCHARGED INTO FRESHWATER

Buikema, A.L., D.R. Lee, and J. Cairns, Jr. 1976.
ASTM Journal of Testing and Evaluation 4(2):120-125.

A simple bioassay method is suggested for on-site toxicity testing of refinery effluents. _Daphnia pulex_ was selected among the array of invertebrates and fish evaluated because it was the most sensitive, relatively inexpensive and easy to maintain, and a potential fish-food organism. In tests of the bioassay method conducted at six petroleum refineries, data show that the method was reproducible and personnel were able to perform the bioassay.

Information Source: J. Cairns, Center for Environmental Studies,
Virginia Polytechnic Institute and State University,
Blacksburg, VA 24061

2. GENERAL EFFECTS

R-107-76
OCSEP

Principal Investigator: Bruce, H.
Performing Organization: U.S. Department of Commerce, Environmental Research Labs, Boulder, CO 80302
Supporting Agency: U.S. Department of the Interior, Bureau of Land Management, No. R7120610
Period: 7/75 to 6/76 Funds: $810,300

Project objectives include establishing an environmental baseline in regions of potential development, defining the ecological impact of oil exploration, production, storage and transport on the OCS, and providing a basis for predictive or diagnostic models of the ecosystem response to loading by petroleum and petroleum by-products. The current program includes physical, biological, chemical, and geological environmental assessment studies on the Gulf of Alaska and Bering Sea outer continental shelves and related shorelines.

[SSIE No. GUK-64]

R-108-76
ECOLOGICAL INVESTIGATION OF ALASKAN NORTH SLOPE OIL FIELD DEVELOPMENT

Principal Investigator: Hanson, W.C.
Performing Organization: Los Alamos Scientific Lab., P.O. Box 1663, Los Alamos, NM 87544
Supporting Agency: U.S. Energy Research and Development Administration, Biomedical and Environmental Research Division
Period: 7/74 to 6/75

Studies are being made of existing distributions of birds, small mammals, caribou and the effect of pipeline construction, and cultural implication of oil development on Eskimo and Indian societies along the route. The implications of the changes to human health of inhabitants, transient workers, and tourists will be stressed.

[SSIE No. CPE-5706]

R-109-76
ENERGY RELATED ENVIRONMENTAL STUDIES

Principal Investigator: Hood, G.C.
Performing Organization: Shell Development Co., P.O. Box 481, Houston, TX 77001
Supporting Agency: Shell Oil Co.
Period: 7/75 to 6/76

The aim of the project is to minimize or eliminate environmental contamination (air, water and ground) created from oil and gas production.

[SSIE No. BM-598-1]

R-110-76

IMPACT ON LAND USE AND VALUE OF ALTERNATE STRATEGIES FOR PRODUCTION, DISTRIBUTION AND UTILIZATION OF ENERGY IN THE PERIOD 1974-2000

Principal Investigator: McFarland, W.F.
Performing Organization: Texas A & M University, Texas Transportation Institute, Highway Research Center, College Station, TX 77843
Supporting Agency: Texas State Government, No. TX-RF185
Period: 9/74 to 12/75

Land use effects of oil and gas drilling and production (on-and off-shore), port construction for tankers, refinery and process plant construction, and other energy-related operations were investigated in Texas. Some indirect economic and environmental effects associated with these activities were also determined.

[SSIE No. YTX-502]

R-111-76

GROUNDWATER CONTAMINATION IN THE SOUTHEAST STATES

Principal Investigators: Miller, D.W., N.M. Perlmutter, and F. Vanderleeden
Performing Organization: Geraghty and Miller Inc., 44 Sintsink Dr. E., Port Washington, NY 11050
Supporting Agency: U.S. Environmental Protection Agency, Office of Research and Development
Period: 7/74 to 6/75 Funds: $66,000

The principal sources of groundwater contamination will be evaluated in Alabama, Florida, Georgia, Mississippi, North Carolina, South Carolina, and Virginia. Findings of this study will be used to develop ways to reduce the number of polluting sources and to point out deficiencies in present methods of groundwater quality protection. Key sources which will be investigated include free-flowing saline-water wells, activities involved in petroleum exploration and development, and leaky industrial waste lagoons.

[SSIE No. GMA-2179]

R-112-76

COASTAL ZONE POLICY STUDY-THE IMPACT OF OFFSHORE OIL AND GAS DEVELOPMENT OF FLORIDA

Principal Investigator: Pearman, A., J.E. Frank, A. Dzurik
Performing Organization: State University of Florida Systems, School of Social Sciences, 205 Wildwood Dr., Talahassee, FL 32306
Supporting Agency: Florida State University
Period: 11/74 to 10/75

Offshore oil development is examined from legal, environmental, economic and social perspectives. The objective of the study is to identify and evaluate a set of policy alternatives which can promote positive regional development while minimizing adverse effects of such development on affected areas.

[SSIE No. NFS-43]

R-113-76

ENERGY RELATED ACTIVITIES AND ASSESSMENT OF WATER RESOURCE MANAGEMENT ALTERNATIVES IN LAKE BOEUF-LAKE DES ALLEMANDS REGION, SOUTH LOUISIANA

Principal Investigators: Whitehurst, C.A., R.H. Chabreck, R.A. Kinney, H. Turner, and R.A. Muller
Performing Organization: Louisiana State University Systems, School of Engineering, University Station, Baton Rouge, LA 70803
Supporting Agency: U.S. Department of the Interior, Office of Water Research and Technology, Contract C-6052
Period: 7/74 to 6/75

This project is a continuation of studies on the Bayou Lafourche Water resources problems. Problems related to the oil and gas drilling industries in an area of South Louisiana were studied. The impact of energy-related activities, including well-drilling, pipeline construction, canal dredging, refinery construction, etc., on the water resources were to be measured.

[SSIE No. GUY-135]

Status: The project will be completed by summer, 1976, and a final report to the Department of Interior will be published by September.

Information Source: C.A. Whitehurst, Louisiana State University and Agricultural and Mechanical College, Baton Rouge, LA 70803

E. FATE OF OIL IN THE ENVIRONMENT

1. BIOLOGICAL DEGRADATION

R-216-74 (renewal)
NAVY ENVIRONMENT-MICROBIAL METABOLISM OF AROMATIC HYDROCARBONS

Principal Investigator: Gibson, D.T., and H.J. Rohlich
Performing Organization: University of Texas, School of Natural Sciences, 200 W. 21st St., Austin, TX 78712
Supporting Agency: U.S. Department of Defense, Navy
Period: 7/76 to 6/77 Funds: $24,000

This investigation on microorganisms that degrade aromatic hydrocarbons found in crude oil is to provide means for the successful treatment of oil spills. Emphasis is placed on the degradation pathways of aromatic hydrocarbons by organisms that can use them for growth. Current work is concentrated on studies of ortho-xylene biodegradation by a Nocardia species.

[SSIE No. GQN-323091-2]

Reports and Publications

THE MICROBIAL DEGRADATION OF AROMATIC PETROLEUM PRODUCTS

Gibson, D.T. 1974.
Office of Naval Research, Annual Report No. 1, Task No. NR 306-054, Contract N00014-67-A-0126-0020. 70p.

The contract provides for the investigation of mechanisms used by soil bacteria in oxidizing ortho-,meta-, and para-xylene.

THE MICROBIAL DEGRADATION OF AROMATIC PETROLEUM PRODUCTS

Gibson, D.T. 1975.
Office of Naval Research, Annual Report No. 2, Task No. NR 306-054, Contract N00014-67-A-0126-0020. 55p.

The purpose of this contract is to investigate mechanisms used by soil bacteria to oxidize ortho-, meta-, and para-xylene and related aromatic compounds. The microbial degradation of the sulfur-containing constituents of crude petroleum is discussed.

THE MICROBIAL DEGRADATION OF AROMATIC PETROLEUM PRODUCTS

Gibson, D.T. 1976.
Office of Naval Research, Annual Report No. 3, Task No. NR 205-008,
Contract N00014-76-C-0102. 48p.

This report describes the degradation ofo-xylene by a species of Nocardia that grows with this hydrocarbon as the sole source of carbon and energy. Biodegradation of o-xylene is initiated by enzymatic oxidation of the aromatic nucleus. Studies on the biodegradation of chlorinated biphenyls are also discussed.

Information Source: D.T. Gibson, Department of Microbiology, University of Texas at Austin, Austin, TX 78712

R-339-74 (renewal)

NAVY ENVIRONMENT: BIOLOGY OF MARINE AND ESTUARINE MICROORGANISMS

Principal Investigators: Colwell, R.R., and J.D. Walker
Department: Microbiology
Performing Organization: University of Maryland, School of Agriculture, College Park, MA 20742
Supporting Agency: U.S. Department of Defense, Navy, DN223667, Contract N00014-75-C-0340
Period: 7/75 to 6/76

The ability of marine and estuarine bacteria to degrade hydrocarbons and petroleum in situ is being tested by a variety of techniques. The biodegradation of lipids and refractory materials in suspended particulates is being examined. The interactions of microorganisms in estuarine and oceanic ecosystems are investigated.

[SSIE No. GQN-223667-2]

For a list of Publications see R-114-76.

R-114-76

DEEP OCEAN ENVIRONMENTAL STUDIES OF MARINE BACTERIA

Principal Investigator: Colwell, R.R.
Performing Organization: University of Maryland, School of Agriculture, College Park, MD 20742
Supporting Agency: U.S. National Science Foundation, Division of Ocean Sciences
Period: 1/76 to 12/76 Funds: $49,500

The objective of this research is to determine the interaction of microorganisms with the deep-ocean environment under in situ conditions.

Microbial activity at low temperature and elevated pressure, and uptake and incorporation of radioactively-labeled nutrients will be examined under in situ conditions. Enrichment experiments using chitin, petroleum compounds, cellulose, urea, etc., will also be conducted in order to provide data for estimating microbial degradation of these materials at ocean depths.

[SSIE No. GSV-4098-3]

Status: The project is in active status. A variety of deep ocean studies are being conducted, particularly hydrostatic effects of pressure on marine bacteria, and the effects of the environment on microbial activities.

Reports and Publications

DEEP-SEA BACTERIA. GROWTH AND UTILIZATION OF N-HEXADECANE AT IN SITU TEMPERATURE AND PRESSURE

Schwarz, J.R., J.D. Walker, and R.R. Colwell. 1975.
Canadian Journal of Microbiology 21(5):682-687.

A mixed culture of bacteria obtained from the sediment-water interface off the Florida coast at a depth of 4940 m utilized n-hexadecane as a sole carbon source for growth at the in situ temperature (4°) and pressure (500 atm). Rate of utilization under deep sea conditions was much slower than the rate observed at ambient pressure (1 atm) and low temperature. (4°).

GROWTH OF DEEP-SEA BACTERIA ON HYDROCARBONS AT AMBIENT AND IN SITU PRESSURE

Schwarz, J.R., J.D. Walker, and R.R. Colwell. 1974.
Technical report, Contract N00014-67-A-0239-0027, Grant NSF-GA-27725. 12p.

Bacteria collected from sediment samples at a depth of 4,940 m off the Florida coast utilized n-tetradecane at both ambient and in situ pressures; however, at ambient temperatures, the rate of hydrocarbon utilization under in situ pressure (500 atm) was significantly less than utilization at ambient pressure (1 atm). Individual isolates from the mixed culture did not utilize n-tetradecane, indicating potential synergistic relationships.

UTILIZATION OF MIXED HYDROCARBON SUBSTRATE BY PETROLEUM-DEGRADING MICROORGANISMS

Walker, J.D., H.F. Austin, and R.R. Colwell. 1975.
Journal of General and Applied Microbiology 21(1):27-39.

The ability of petroleum-degrading yeasts, fungi, and bacteria to degrade a mixed hydrocarbon substrate is reported. Cumene, naphthalene, phenanthrene, pristane, 1, 2-benzanthracene, perylene, and pyrene were degraded by microorganisms. The patterns for hydrocarbon utilization were similar for bacteria, yeasts and fungi; however, utilization by individual isolates varied significantly.

ENUMERATION OF PETROLEUM DEGRADING MICROORGANISMS

Walker, J.D., and R.R. Colwell. 1976.
Applied and Environmental Microbiology 31(2):198-207.

The effects of various factors, including oil concentration, antibiotics, dyes, and inoculum washes, on the total counts of microorganisms on oil-containing media were determined. Media containing 0.5% (vol/vol) oil and 0.003% phenol red, with Fungizone added for isolating bacteria and streptomycin and tetracycline added for yeasts and fungi, was found to be best for enumerating petroleum degraders. Incubation temperature and presence of oil were found to affect the numbers of petroleum-degrading microorganisms at sampling sites.

MEASURING THE POTENTIAL ACTIVITY OF PETROLEUM-DEGRADING BACTERIA

Walker, J.D., and R.R. Colwell. 1976.
Applied and Environmental Microbiology 31(2):189-197.

[C^{-14}] hydrocarbons were used to evaluate the hydrocarbon-degrading potential of bacteria in estuarine and marine environments. Amount of mineralization of [C^{-14}] hexadecane can be equated with the total number of petroleum-degrading bacteria and the percentage of the total heterotrophic bacteria population which they represent.

MICROBIAL PETROLEUM DEGRADATION: USE OF MIXED HYDROCARBON SUBSTRATES

Walker, J.D., and R.R. Colwell. 1974.
Applied Microbiology 27(6):1053-1060.

A comparison is made of methods estimating the microbial degradation of petroleum. Gas-liquid chromatography with a mixed hydrocarbon substrate is shown to be a useful method for evaluating the microbial potential of hydrocarbon degradation.

BACTERIAL DEGRADATION OF MOTOR OIL

Walker, J.D., R.R. Colwell, and L. Petrakis. 1975.
Journal of the Water Pollution Control Federation 47(8):2058-2066.

Natural populations of bacteria were used to attempt to degrade petroleum under both optimum and real-world conditions. Oil discharged from wastewater treatment plants can be biodegraded. Microorganisms in the water column have more potential for biodegradation of oils than those in the sediments.

BIODEGRADATION OF PETROLEUM BY CHESAPEAKE BAY SEDIMENT BACTERIA

Walker, J.D., R.R. Colwell, and L. Petrakis. 1976.
Canadian Journal of Microbiology 22(3): 423-428.

Degradation products of petroleum-degrading bacteria from oil-free and oil polluted sediments were analyzed and compared using techniques of preferential solubility, column chromatography, gas-liquid chromatography and mass spectrometry. Microorganisms from oil polluted sediments effectively utilized saturated and aromatic hydrocarbons, whereas those from oil-free sediments produced greater quantities of residual asphaltenes.

EVALUATION OF PETROLEUM-DEGRADING POTENTIAL OF BACTERIA FROM WATER AND SEDIMENT

Walker, J.D., R.R. Colwell, and L. Petrakis. 1975.
Applied Microbiology 30(6):1036-1039.

Bacteria from water and sediment of an oil-polluted harbor were examined for ability to degrade petroleum. Water samples contained a larger variety of oil-degrading bacteria than sediment samples. These bacteria produced significantly greater degradation of several hydrocarbons than bacteria from the sediment.

MICROBIAL DEGRADATION: APPLICATION OF COMPUTERIZED MASS SPECTROMETRY

Walker, J.D., R.R. Colwell, and L. Petrakis. 1975.
Canadian Journal of Microbiology 21(11):1760-1967.

The use of computerized low-resolution mass spectrometry is offered as a method for elucidating microbial degradation of petroleum. In this study the degradation of a South Louisiana crude oil by a mixed culture of estuarine bacteria was evaluated using this procedure.

COMPARISON OF THE BIODEGRADABILITY OF CRUDE AND FUEL OILS

Walker, J.D., L. Petrakis, and R.R. Colwell. 1976.
Canadian Journal of Microbiology 22(4):598-602.

The ability of two crude and two fuel oils to support growth of a mixed population of estuarine bacteria was examined. Each of the oils supported a unique population of bacteria and yeasts. Low sulfur, high saturate South Louisiana crude oil was highly susceptible to degradation; in contrast, the dense high sulfur Bunker C fuel oil was strongly recalcitrant to biodegradation.

EFFECT OF SOUTH LOUISIANA CRUDE OIL AND NO. 2 FUEL OIL ON THE GROWTH OF HETEROTROPHIC MICROORGANISMS, INCLUDING PROTEOLYTIC, LIPOLYTIC, CHITINOLYTIC AND CELLULOLYTIC BACTERIA

Walker, J.D., P.A. Seesman, and R.R. Colwell. 1975.
Environmental Pollution 9(1):13-33.

The susceptibility of autochthonous microorganisms from Muddy Creek (Chesapeake Bay) to South Louisiana crude oil and No. 2 fuel oil was tested. The sediment from the creek was free of oil. The yeast and fungi populations did not react to either the crude or fuel oil. But both crude and fuel oil were toxic to bacteria of all types.

Information Source: R.R. Colwell, Department of Microbiology,
University of Maryland, College Park 20742

R-115-76

ECOLOGICAL STUDIES ON HYDROCARBON-OXIDIZING BACTERIA IN THE SEA POLLUTED WITH PETROLEUM

Principal Investigator: Fujisawa, H.
Performing Organization: Shimonoseki University of Fisheries,
Department of Microbiology, 1944 Yoshiminagata-honmachi, Shimonoseki, Japan
Supporting Agency: Unknown
Period: Unknown (in progress)

The investigator is studying the distribution of hydrocarbon oxidizers in seas polluted from the Mizushima Refinery Plant as part of the project on petroleum pollution.

[Aquatic Microbiology Newsletter 15(1):25]

Reports and Publications

STUDIES ON SLIME-LIKE SUBSTANCE FORMED IN DRAINAGE SYSTEM OF REFINERY PLANT. I. CHEMICAL PROPERTIES OF SLIME-LIKE SUBSTANCE AND ENVIRONMENTAL FACTORS CONNECTED WITH ITS FORMATION

Fujisawa, H., and M. Murakami. 1973.
Journal Shimonoseki University of Fisheries 22:29-38.

STUDIES ON SLIME-LIKE SUBSTANCE FORMED IN DRAINAGE SYSTEM OF REFINERY PLANT. II. BACTERIA AND OTHER MICROORGANISMS IN SLIME-LIKE SUBSTANCE, WASTE WATER AND INDUSTRIAL WATER

Fujisawa, H., and M. Murakami. 1973.
Journal Shimonoseki University of Fisheries 22:39-48.

STUDIES ON SLIME-LIKE SUBSTANCE FORMED IN DRAINAGE SYSTEM OF REFINERY PLANT. III. SLIME-LIKE SUBSTANCE ON SLIDE GLASS OR PIPE SUBMERGED IN WASTE WATER AND INHABITING MICROORGANISMS

Fujisawa, H., and M. Murakami. 1973.
Journal Shimonoseki University of Fisheries 22:55-66.

STUDIES ON SLIME-LIKE SUBSTANCES FORMED IN DRAINAGE SYSTEM OF REFINERY PLANT. IV. PROMOTIVE AND INHIBITORY CONDITIONS OF ITS GROWTH

Fujisawa, H., and M. Murakami. 1974.
Journal Shimonoseki University of Fisheries 23:25-30.

STUDIES ON HYDROCARBON-OXIDIZING BACTERIA IN THE COASTAL WATERS
I. SOME METHODS OF ENUMERATION OF HYDROCARBON OXIDIZING BACTERIA

Fujisawa, H., M. Murakami, and T. Manabe.
Bulletin of the Japanese Society of Scientific Fisheries. (in press)

Some methods to enumerate hydrocarbon oxidizers in Japanese coastal waters which receive various petroleum and organic pollutants are examined in this paper.

Information Source: H. Fujisawa, Shimonoseki University of Fisheries,
Yoshimi, Shimonoseki, Japan

R-116-76

MICROBIAL ATTACK ON SYNTHETIC CRUDE PETROLEUM OBTAINED FROM ATHABASCA BITUMEN

Principal Investigator: Jobson, A.M.
Performing Organization: Alberta Research Council, 11315 87th Ave.,
Edmonton, Alberta T6G 2C2, Canada
Supporting Agency: Unknown
Period: Unknown

Summary not available.

[Aquatic Microbiology Newsletter 15(1):28]

Status: The investigator is conducting a small project concerned with the penetration of agricultural class soil by synthetic crude petroleum and its apparent degradation, or lack thereof, by microorganisms. Results have not been published at this time. The following publications have resulted from previous research.

Reports and Publications

BACTERIAL DEGRADATION OF CRUDE OIL: COMPARISON OF FIELD AND EXPERIMENTAL DATA

Bailey, N.J.L., A.M. Jobson, and M.A. Rogers. 1973.
Chemical Geology 11:203-221.

PHYSIOLOGICAL CHARACTERIZATION OF A DESULFOVIBRIO SP. ISOLATED FROM CRUDE PETROLEUM

Jobson, A.M. 1975.
Ph.D. Thesis, University of Alberta

MICROBIAL UTILIZATION OF CRUDE OIL

Jobson, A.M., F.D. Cook, and D.W.S. Westlake. 1972.
Applied Microbiology 23:1082-1089.

EFFECTS OF AMENDMENTS ON THE MICROBIOLOGICAL UTILIZATION OF OIL APPLIED TO SOIL

Jobson, A.M., M. McLaughlin, F.D. Cook, and D.W.S. Westlake. 1974.
Applied Microbiology 27:166-171.

BIODEGRADABILITY AND CRUDE OIL COMPOSITION

Westlake, D.W.S., A.M. Jobson, R. Phillippe, and F.D. Cook. 1974.
Canadian Journal of Microbiology 20:915-928.

Information Source: A.M. Jobson, Alberta Research Council, Physical Sciences Branch, 11315-87th Ave., Edmonton, Alberta, Canada T6G 2C2

R-117-76
BIODEGRADATION OF OIL

Principal Investigator: Sedita, S.J., P.A. Boyle, and J.P. McGivern
Performing Organization: Houston Research Inc., 8330 Broadway, Houston, TX 77012
Supporting Agency: Department of the Navy, Office of Naval Research
Period: 5/72 to ?

The contract provides for the evaluation of previously isolated and newly isolated microorganisms for their ability to oxidize oil; comparison of combined microbial systems (intact and disrupted cells) with intact cells for rapid oxidation of an oil slick under optimum conditions; and data for design concepts and environmental acceptability criteria.

Results: Forty hydrocarbon-degrading microorganisms have been isolated and have been partially characterized physiologically and morphologically. Hydrocarbon oxidizing capabilities are being evaluated. In these studies removal of paraffinic compounds is significant, whereas naphthenics and aromatics increase correspondingly. The asphaltic component remains constant. One experiment to determine the effectiveness of the technique has been carried out using a mixed culture and disrupted and intact cells. The disrupted cell approach is being evaluated as a possible technique for the biodegradation of hydrocarbons on a pilot scale (1200 l seawater plus 100 ml oil).

Information Source: MRIS Abstracts 12. 1975.

R-118-76

MICROBIAL BIODEGRADATION OF ECOLOGICALLY IMPORTANT MATERIALS

Principal Investigator: Traxler, R.W.
Performing Organization: University of Rhode Island, Agricultural Experiment Station, Adminstration Building, Kingston, RI 02881
Supporting Agency: U.S. Department of Agriculture, Cooperative State Research Service, Rhode Island, No. 0063209, RI00631
Period: 7/75 to 6/76

The project will determine the rate and extent of degradation, degradation pathways, and the products of degradation and their toxicities for many materials arising from agricultural, industrial and other operations. A field study has demonstrated bacterial population shifts which occur in beach sediments following an oil spill in Narragansett Bay. Data have been provided on degradation rates of oil components at psychrophilic temperatures and the effects of hydrocarbons on cellular structure.

[SSIE No. GY-63209-2]

Status: A list of publications resulting from the project appears in Oil Spill and Oil Pollution Reports, February'76, April, '76, p.241-243.

Reports and Publications

MORPHOLOGY AND ULTRASTRUCTURE OF A PENICILLIUM SP. GROWN ON N-HEXADECANE OR PEPTONE

Cundell, A.M., W.C. Mueller, and R.W. Traxler. 1976.
Applied and Environmental Microbiology 31(3):408-414.

The study was designed to compare the morphology and ultrastructure of a Penicillium sp. when grown in liquid culture on n-hexadecane or peptone using transmission and scanning electron microscopy. The fungus grew as hollow mycelial balls surrounding individual hydrocarbon droplets on n-hexadecane and as solid mycelial balls on peptone. Inclusions were present in the hexadecane-grown mycelium that were absent when the fungus was grown on peptone. These findings support the generality that hydrocarbons are sequestered in bacteria, yeast, and fungi.

Information Source: R.W. Traxler, Agricultural Experiment Station, University of Rhode Island, Kingston, RI 02881

R-119-76
CLEANUP OF OIL IN SOIL BY BIODEGRADATION

Principal Investigator: Unknown
Performing Organization: Sun Ventures, Inc.
Supporting Agency: American Petroleum Institute (OS-21 Series)
Period: Unknown (one-year study)

The project consists of monitoring the fate and effects of oil introduced into 42 plots located at Marcus Hook, Pennsylvania, Tulsa, Oklahoma, and Corpus Christi, Texas. Sampling is at six-month intervals. Oil concentration and changes in gross composition will be determined. Once during the year the plots will be seeded to determine phytotoxicity effects.

[Environmental Research, Annual Status Report. API Publication No. 4275. February, 1976]

2. GENERAL FATE OF OIL

R-160-74
FATE OF OIL IN A WATER ENVIRONMENT: A REVIEW, EVALUATION AND BIBLIOGRAPHY OF LITERATURE

Principal Investigator: Kolpack, R.L.
Performing Organization: University of Southern California, Graduate School, Los Angeles, CA 90007
Supporting Agency: American Petroleum Institute
Period: 7/73 to 6/74 Funds: $100,000

A literature review was compiled concerning the area of oil transport in a water environment. The study was mainly concerned with aquatic parameters in reservoirs.

[SSIE No. PAP-61]

Status: The Annotated Bibliography of Selected Literature, Volume II of the Phase I report, has been published (API Publication No. 4213).

Information Source: Environmental Research, Annual Status Report.
API Publication No. 4275. February, 1976.

R-120-76
INTERACTION OF CHEMICAL POLLUTANTS AND MICROORGANISMS IN THE NEW JERSEY [sic]

Principal Investigator: Bartha, R., and A.D. Antoine
Performing Organization: Rutgers The State University, Agricultural Experiment Station, Old Queens Building, New Brunswick, NJ 08903
Supporting Agency: U.S. Department of Agriculture, Cooperative State Research Service, New Jersey, No.0068007 NJ00507
Period: 7/75 to 6/76

The interaction of chemical pollutants such as petroleum hydrocarbons, polychlorinated biphenyls, pesticide residues, heavy metals, and pollutants that give rise to eutrophication with estuarine microorganisms will be investigated. The action of pollutants on essential microbial processes (biodegradation, nitrification, etc.) and the concentration of pollutants in microorganisms and in higher members in estuarine food chains will be determined.

[SSIE No. GY-68007]

R-121-76

FATE OF OIL IN A WATER ENVIRONMENT: MATERIAL BALANCE OF AN OIL SPILL

Principal Investigator: Kolpack, R.L.
Performing Organization: University of Southern California, Graduate School, Los Angeles, CA 90007
Supporting Agency: American Petroleum Institute, No. OS-20F
Period: 1/75 to 1/76

The project objective was to develop a computerized model capable of describing and perhaps predicting the actual exposure of marine animals to major hydrocarbon fractions found in an oil spill.

Status: A status report covering the development of a mathematical simulation model has been submitted. The research program in 1975 focuses on improvement of model efficiency, systematic development of algorithms, testing of the model, and setting priorities for future research. Work on this project (Phase II) was scheduled to be completed by January, 1976. The final report will be in two volumes: I, Mechanics and Structure of the Oil Spill Model; and II, Validation. For Volume II, model predictions were compared against known spill data from Santa Barbara and Chesapeake Bay (controlled experimental spills) and Chedabucto Bay (accidental spill). Correlations between predictions vs. actual spill trajectories were obtained.

[Environmental Research, Annual Status Report. American Petroleum Institute Publication No. 4275. February, 1976]

R-122-76

FATE OF OIL IN A WATER ENVIRONMENT: DILUTION STUDY OF A CONTROLLED OIL SPILL

Principal Investigator: Unknown
Performing Organization: JBF Scientific Corporation
Supporting Agency: American Petroleum Institute, No. 201-75
Period: Unknown

This project supplements the University of California study for development of an oil spill mathematical model. Oil spill tests at sea have been designed and conducted in order to obtain physical and chemical data on the dispersion of all oil slicks in the water column by natural forces.

Several hundred samples were obtained from slicks generated by four planned oil spills conducted by the contractor and from 1.5 and 3 meter depths in the water column. Selected samples were analyzed by Exxon Research and Engineering Company and Chevron Oil Field Research Company laboratories. A final report and conclusions will be prepared and other data submitted.

[Environmental Research, Annual Status Report, API Publication No. 4275. February, 1976]

F. OIL POLLUTION REGULATIONS

1. STANDARDS AND GUIDELINES

R-123-76
PREPARATION OF TECHNICAL GUIDELINES FOR ENVIRONMENTAL PROTECTION FOR OIL PIPELINES

Principal Investigator: Unknown
Performing Organization: Beak Consultants Ltd., Calgary, Alberta Canada
Supporting Agency: Canada Department of the Environment
Period: 7/75 to 6/76 Funds: $10,190

No summary provided to SSIE.

[SSIE No. WDB-35]

Reports and Publications

PREPARATION OF TECHNICAL GUIDELINES FOR ENVIRONMENTAL PROTECTION FROM OIL PIPELINES

Beak Consultants Ltd.
Prepared for Environmental Protection Service, Environment Canada, Place Vincent Massey, Ottawa, Ontario, Canada K1A 0H3

Information Source: E.M. Wright, Assistant Manager, Beak Consultants Ltd., 3530-11A Street NE, Calgary, Alberta, Canada T2E 6M7

SECTION III. CURRENT CONFERENCES

*Additional information not available at time of publication

*May 3-7 Joint IOC/WMO Subgroup of Experts on the IGOSS Marine Pollution (Petroleum) Monitoring Pilot Project, 1st Session, London, England, 1976.

FFI contact The Secretary-General, UNESCO, Intergovernmental Oceanographic Commission, Place de Fonteney, 75700 Paris, France

See also June 14-18: Second IOC/WMO workshop on Marine Pollution (Petroleum) Monitoring

May 4-6 Conference on Great Lakes Research, 19th, and Annual Meeting of the International Association for Great Lakes Research, University of Guelph, Guelph, Ontario, 1976.

Oil Pollution Related Papers

Session 5d: Sediment Quality

SIMPLIFIED MODEL CONCERNING CHANGES IN SEDIMENT QUALITY
Sweeney, R.A., and R.K. Wyeth

Based on a one-year study of a one hundred square-mile (approximately 260 km^2) area in Lake Erie, off Cleveland, a simplified chemical model was developed as an aid to understanding changes in sediment quality with time. Oils were included among the parameters considered in the model. The model was found to be of value in explaining the distribution of benthos in the study area and may be applicable to other Great Lakes regions.

FFI contact Conference Coordinator, 19th Annual Great Lakes Conference, P.O. Box 4123, U.S. Post Office, 1200 William St., Buffalo, N.Y. 14240

May 10-13 American Petroleum Institute Refining Department Midyear Meeting, 41st, Los Angeles, California 1976.

Emphasis of the meeting was on energy conservation in the use and refining of petroleum products and the petroleum industry's responses to the need for conserving energy and resources.

Oil Pollution Related Papers

Session on Conservation of Products in Nonautomotive Applications.

Preprint 30-76
RE-REFINING: ECONOMICALLY ATTRACTIVE WAY TO CONSERVE LUBE OIL
Cutler, E.T.

The need to recycle waste automotive lubricating oil and similar waste oils is discussed and the present disincentives to recycling are reviewed. Economic and technical details of a new re-refining process, the PVH(propane-vacuum-hydrogen) process, are presented; advantages of the PVH process over other waste oil treatments and virgin lube oil refining are outlined.

Session on Conservation in Refinery Environmental Control

Preprint 32-76
COST-EFFECTIVE TREATMENT OF A PETROLEUM REFINERY EFFLUENT
Crame, L.W.

Texaco recently conducted a series of studies at its West Tulsa, Oklahoma refinery to develop a cost-effective method for treating and disposing of refinery wastewaters. The paper details the scope of these studies and discusses the technological and economic options available for refinery wastewater treatment modification. On the basis of the studies, conversion to a rotating disk biological treatment system coupled with several modifications, such as improvement of the oil-water separation system, was recommended and implemented.

Session on Advances in Processing

Preprint 40-76
FLEXICOKING--CLEAN PRODUCTS FROM DIRTY FEEDS
Griffel, J., G.E. Phillips, and J.C. Spry

A recently developed thermal cracking process called FLEXICOKING is capable of converting undesirable high-metal, high sulfur, residual petroleum crudes into clean petroleum products and environmentally acceptable fuel gases. The paper describes and discusses the process, its economics, and its broad applicability to low-grade feedstocks.

Conference Proceedings available ($15.00 per set) from API Publications and Distribution Section, 2101 L St.Northwest, Washington, D.C. 20037

May 12-14 Offshore Impacts of South Atlantic OCS Development, Savannah, Georgia, 1976.
Sponsored by the Coastal Plains Marine Center.

The conference examined the onshore impact of South Atlantic Outer Continental Shelf (OCS) oil and natural gas development. Topics covered included oil industry impacts, economic effects, ecological impacts, secondary and tertiary impacts, the legal framework and intergovernmental relations, and the role of the citizen.

FFI contact Mr. Hans Heuhauser, Director of the Coastal Office of the Georgia Conservancy, 4405 Paulsen St., Savannah, GA 31405

May 24-28 Offshore Wales Exhibition and Conference, Cardiff, Wales, 1976.

The conference promoted and reported gas and oil development activities in the offshore Wales (Celtic Sea) region. Papers covered various aspects of offshore exploration and production, offshore technology, and environmental control.

Oil Pollution Related Papers

Session on Offshore Maintenance Engineering and Environmental Control

ENVIRONMENTAL CONSEQUENCES
Nelson-Smith, A., and J.M. Baker

OIL POLLUTION CONTROL IN MILFORD HAVEN
Sulivan, J.

Conference proceedings available at L5 per set from Dr. E.G. Hellewell, Department of Mineral Exploitation, University College, P.O. Box 97, Cardiff CF1 1XP, Wales, U.K.

May 31-
June 4 Clean Air and Water Exhibition, U.S. Trade Center, Sydney, Australia, 1976.
Sponsored by the U.S. Department of Commerce.

This trade exhibition included a technical seminar featuring the latest in U.S. pollution abatement and monitoring technology.

Oil Pollution Related Papers

OIL SPILL RECOVERY PROBLEMS AND TECHNIQUES
Medicus, J.M.

The Oil Mop, Inc. harbor oil spill recovery systems and theoretical open sea recovery techniques, oil/water separators and barge/ship cleaning procedures are described.

The company's spill recovery system is based on a patented, oil-absorbent,water repellent rope mop manufactured in lengths up to about 460 m. After absorption, the rope is pulled through squeegee rollers to squeeze out the oil. Recovery rates of about 400 barrels per hour are reported. The company is based in Belle Chasse, La. 70037.

FFI contact Irwin D. Nathanson, Australasia; Office of International Marketing, U.S. Department of Commerce, Washington, D.C. 20230

June 6-9 Chemical Conference and Exposition, 59th, London, Ontario, 1976. Cosponsored by the Chemical Institute of Canada and the Spectroscopy Society of Canada

Oil Pollution Related Papers

Analytical Chemistry Division
Session I: Environmental analysis

AN-3
APPLICATIONS OF MASS SPECTROMETRY IN ENVIRONMENTAL ANALYSIS: SOURCES OF GROUNDWATER POLLUTION
Sakuma, I., W.K. Dukolke, O. Meresz, and D. Robinson.

AN-4
DETERMINATION OF TRACE QUANTITIES OF PHENOLIC COMPOUNDS IN WATER
Smith, L.S.

Canadian Society for Chemical Engineering, Environmental Affairs Group
Session III: Chemicals in the Environment

EN-1
THE FATE OF HYDROCARBONS IN THE CANADIAN ARCTIC
Mackay, D.

Session VIII: Environmental Impact and Cost-Benefit Studies

EN-10
CHEMICALS IN THE ENVIRONMENT
Brydon, J.E.

Conference abstracts are available ($10.00 per set) from the Chemical Institute of Canada, 151 Slater St., 906 Ottawa, Ontario K1P SH3, Canada

June 14-18 IOC/WMO Workshop on Marine Pollution (Petroleum) Monitoring, 2nd, Monaco, 1976.
Cosponsored by the World Meteorological Organization and the Intergovernmental Oceanographic Commission.

The objectives of the second workshop were to 1) review and evaluate the progress made during the first year of the IGOSS Pilot Project on Marine Pollution (Petroleum) Monitoring (3-7 May, 1976); 2) to obtain scientific advice related to improvement of the present Pilot Project through lectures and panel discussions at the workshop; and 3) to consider possible options for further development of the Pilot Project.

Oil Pollution Related Papers

INPUT OF OIL AND ITS SUBSEQUENT DISTRIBUTION IN THE MARINE ENVIRONMENT

Levy, E.M.

"The inputs of petroleum to the marine environment and the pathways by which it is distributed are discussed briefly. Existing concentration levels in each of the marine reservoirs are considered in detail, with particular emphasis on the distribution of tar on the surface of the ocean and of dissolved/dispersed petroleum residues in the water column."

THE ENVIRONMENTAL FATES OF PETROLEUM IN MARINE WATERS

Morris, B.

Environmental processes which result in alteration and elimination of crude oil after spillage are detailed. Evaporation and solution are initially the most important processes and can remove up to 60% of the hydrocarbons of crude oils within a few days. The slower weathering processes, including photooxidation, chemical (auto-) oxidation, and microbial degradation then become dominant. These oxidative processes are most effective with dispersed oils, followed by thin surface films, oil in water emulsions, surface slicks, and tar lumps. Beaching, sinking, and physical disintegration are the fates of residual, inert, asphaltene hydrocarbons in the environment.

ECOLOGICAL EFFECTS OF OIL

Stegeman, J.C.

Research trends since 1970 are discussed in regard to the following aspects of oil pollution: 1) Bioaccumulation of hydrocarbons with emphasis on mechanisms and pharmacokinetics; 2) The acute and chronic effects of various oils, their specific components, and oil dispersants on the metabolism and physiology of various faunal and floral assemblages; and 3) The mechanisms and effects of hydrocarbon metabolism. In addition, the paper identifies necessary areas for future research efforts.

SAMPLING, METHODOLOGY, INSTRUMENTATION AND STANDARDS FOR PETROLEUM ANALYSIS IN THE MARINE ENVIRONMENT
Zsolnay, A.

Various procedures used in the detection and monitoring of oil pollutants are discussed. Emphasis is placed on comprehensive proceudres which give the greatest return for expendable efforts in any particular analysis. Methods used in sampling, extraction, concentration and quantification are reviewed. The problem of calibration among the many analytical laboratories around the world is also covered.

A report of the workshop is available through The Secretary-General, World Meteorological Organization, CH-1211.
Sponsored by the European Federation of Chemical Engineering.

June 20-26 ACHEMA '76--Chemical Engineering Exhibition-Congress, Frankfurt/Main, Federal Republic of Germany, 1976
Sporsored by the European Federation of Chemical Engineering.

The congress featured a comprehensive program of scientific and technical topics, including new developments in several phases of pollution control.

Oil Pollution Related Papers

Session on Waste Gases, Wastewater, Refuse and Recycling, Noise

ELIMINIERUNG VON LIPOPHILEN BELASTUNGSSTOFFEN BEI DER WASSER AUFBEREITUNG (ELIMINATION OF LIPOPHILIC CONTAMINANTS DURING THE RECLAMATION OF WATER)
Weil, L., K.E. Quentin, and H. Berger

UNTERSUCHUNGEN ZUR WIRTSCHAFTLICHEN UND SCHADLOSEN BESEITIGUNG VON ALTEMULSIONEN UND ÖLHALTIGEN SPÜLWÄSSERN ZWEIER KALTWALZWERKE. (INVESTIGATIONS BEARING ON THE ECONOMICAL AND SAFE DISPOSAL OF SPENT EMULSIONS AND OILY WASH WATERS FROM TWO COLD ROLLING MILLS)
Steinbach, G., H. Kroener, and W. Meininghaus

EMULSIONSTRENNUNG DURCH THERMISCHE BEHANDLUNG ODER ULTRAFILTRATION UND KOMBINIERT (DEMULSIFICATION OF EMULSIONS BY THERMAL TREATMENT AND/OR ULTRAFILTRATION)
Knobloch, H.

FFI contact National Chemical Exposition, 26 E. Randolph St.,
Chicago, IL 60601

June 20-24 American Society of Limnology and Oceanography, Savannah, Georgia, 1976.

Oil Pollution Related Papers

Session II: Fate of Organic Pollutants

FATE OF PETROLEUM HYDROCARBONS IN ESTUARINE WATERS
Lee, R.F., and H.W. Paerl

EFFECTS OF THE WATER SOLUBLE COMPONENTS OF PETROLEUM ON ALKALINE PHOSPHATASE AND PHOSPHODIESTERASE FROM CYCLOTELLA MENEGHINIANA
Fehler, S.W.G., and J.A. Calder

OIL POLLUTION: EFFECTS OF CRUDE OIL AND FUEL OILS ON MICROALGAE
Batterton, J.C., K. Winters, and C. Van Baalen

FFI contact Dr. J.F. McGowan, Skidaway Institute of Oceanography,
55 W. Bluff Rd., Savannah GA 31402

June 27-30 The Third National Conference on Complete WateReuse: Symbiosis as a Means of Abatement for Multi-Media Pollution, Cincinnati, Ohio, 1976.

The main theme of the conference was to explore and promote possible symbiotic relationships between disparate entities such as industries, municipalities, farms and institutions which generate liquid wastes, and those that can recycle or utilize waste products.

Oil Pollution Related Papers

8th Plenary Session: Reverse Osmosis and Ion Exchange

CONCENTRATION OF OILY AND LATEX WASTEWATERS USING ULTRAFILTRATION INORGANIC MEMBRANES
Bansal, I.K.

The paper discusses pilot-plant and laboratory results of the use of inorganic ultrafiltration membranes for concentrating oil and other substances in wastewaters. By using ultrafiltration techniques, the need for and cost of disposing of these wastewaters is greatly reduced.

10th Plenary Session: Power

ENVIRONMENTAL ASSESSMENT OF COMBUSTION PROCESSES FOR INDUSTRIAL-MUNICIPAL SYMBIOSIS IN REFUSE DISPOSAL
Reed, J.C., J.D. Cobb, and J.C. Ting

The paper is in part a discussion of some environmental aspects of the use of refuse, such as sewage sludge and waste oil, as fuels in municipal and industrial applications.

FFI concerning the conference proceedings contact Mr. Lawrence K. Cecil, Conference Program Chair., 418 Lincoln Building, 44 Main Street, Champaign, IL 61820

June 28-
July 1

World Congress on Chemical Engineering, Amsterdam, The Netherlands, 1976. Cosponsored by the European Federation of Chemical Engineering and the Interamerican Confederation of Chemical Engineering.

The theme, "Chemical Engineering in a Changing World", sought to direct chemical engineering research and development activities toward resolving main world problem areas, including environmental pollution.

Oil Pollution Related Papers

Session B3: Loss Prevention

DEVELOPMENT IN THE TRANSPORT AND STORAGE OF HAZARDOUS SUBSTANCES
Buschmann, C.H.

THE ACTIVITIES OF THE HYDROCARBON OXIDATION STUDY GROUP
Kletz, T.A.

RESEARCH IN LOSS PREVENTION
Joschek, H.I.

EFFECTIVE SOFTWARE IN LOSS PREVENTION (E.G. PROCEDURES, TRAINING AND ORGANIZATION)
Kolodner, H.J.

Session A5: Environment and Human Activities

ADVANCED TREATMENT OF INDUSTRIAL WASTE WATERS
Eckenfelder, W.W.

Session B7: Distillation, Absorption and Extraction

FRACTIONATING PROCESSES FOR ENVIRONMENTAL PROTECTION
Billet, R.

Conference proceedings are available from Elsevier Scientific Publishing Company, P.O. Box 330, Amsterdam, the Netherlands

*June 28-July 3 Session of the Working Committee for the Global Investigation of Pollution in the Marine Environment, Hamburg, Federal Republic of Germany, 1976.
FFI contact Intergovernmental Oceanographic Commission, Place de Fonteney, 75700 Paris, France

July 12-16 CICAR-I Symposium: Progress in Marine Research in the Caribbean and Adjacent Regions, Caracas, Venezuela, 1976.

Oil Pollution Related Papers

GUIDELINES FOR REGIONAL BASELINE STUDIES OF CONTAMINANTS IN COASTAL AREAS
Mandelli, E.F.

Guidelines have been formulated for organizing regional baseline studies of offshore contaminant inputs such as petroleum. The scope of such studies should include the detection and control of contaminants not considered dangerous at present levels.

RELATIONSHIP OF SCARLET PRAWN (*PLESIOPENAEUS EDWARDSIANUS*) TO A BENTHIC OIL DEPOSIT OFF THE NORTHWEST COAST OF ARUBA, DUTCH WEST INDIES
Thompson, H.C., Jr., R.N. Farragut, and M.H. Thompson

During research cruises of the FRV OREGON II in 1970 and 1973, substantially larger quantities of scarlet prawns were found in areas of a benthic oil deposit than in adjacent unpolluted ocean floor. Chemical analysis indicates that in the areas of oil the prawns contained abnormally high quantities of an unusual N-paraffin hydrocarbon series. A probable explanation for the greater abundance of crustaceans in the oil polluted areas is discussed.

A BASELINE STUDY ON THE LEVELS OF SOME CONTAMINANTS IN TERMINOS LAGOON, CAMPECHE, MEXICO
Botello, A.V., E. Hicks, and E.F. Mandelli

Pollution studies were conducted for heavy metals, and biogenic and fossil hydrocarbons present in the seawater sediments and marine organisms of a coastal lagoon near Campeche, Mexico. The lagoon was chosen as a preindustrialization model for comparison with other coastal lagoons. The analysis of hydrocarbons in the sediments was found to be useful in delineating areas affected by harbor activities.

FFI concerning proceedings contact Harris B. Stewart, J., Chairman CICAR-II Steering Committee, NOAA Atlantic Oceanographic and Meteorological Laboratories, 15 Rickenbacker Causeway, Miami, FL 33149

*Aug. 9-11 Symposium on Sources, Effects and Sinks of Hydrocarbons in the Aquatic Environment, American University, Washington, D.C. 1976.

FFI contact the American Institute of Biological Sciences, 1401 Wilson Blvd., Arlington, VA 22209

*Aug. 9-12 Environmental Management of the Coastal Zone Seminar, Drexel University, Philadelphia, Pennsylvania, 1976.

The seminar will include papers relevant to environment aspects of oil.

Published proceedings are available at $25.00 per set from Dr. R.B. Newman, Director, Continuing Professional Education, Drexel University, 32nd and Chestnut Sts., Philadelphia, PA 19104

*Aug. 29-Sept. 3 American Chemical Society, Division of Environmental Chemistry, 172nd, San Francisco, California, 1976.

FFI contact ACS Meetings Department, 1155 16th St. Northwest, Washington, D.C. 20036

Sept. 13-15 OCEANS '76, Washington, D.C., 1976.
Sponsored by the Marine Technology Society and the IEEE Council on Oceanic Engineering.

The theme of OCEANS '76, "Ocean Imperatives", emphasizes the critical impact of oceans on the quality of life on earth. The technical program presents recent contributions to the knowledge of oceans by marine science and technology, and seeks to promote cooperative international efforts in protecting and conserving oceans and ocean resources.

Oil Pollution Related Papers

Session 7: Economic Potential

Paper 7C
GEORGES BANK PETROLEUM DEVELOPMENT AND THE COMMERCIAL FISHING INDUSTRY
Grigalunas, T.A., and J.G. Sutinen

Summary not available.

Session 12: Water Quality/Pollution Control

Paper 12C
PARAMETRIC STUDY OF THE HYDRODYNAMIC PERFORMANCE OF THE LOCKHEED DISC-DRUM OIL SLICK RECOVERY DEVICE
Chung, J.S., and C.E. Rudiger

The paper presents an evaluation of the oil recovery performance of "Clean Sweep", Lockheed's High Seas Oil Recovery System (HORS) which was developed under U.S. Coast Guard contract. Parameters considered in the analysis of full-scale and model-scale units are oil properties, sea states, relative current velocities, optimum disc rotation rate for maximum recovery, and the rate of oil feeding into the disc. More than 100 "Clean Sweep" devices have been tested in sheltered water to open sea conditions, and their recovery rates are nearly 3800 liters/minute with less than 5 percent water content.

Paper 12F
DEVELOPMENT OF AN OIL-WATER POLLUTION MONITOR
Tyler, B.D., and T.M. Houlihan

"The prototype of an automatic oil pollution monitor using a Direct Difference Method of Total Organic Carbon Determination was built and tested. Using this monitor, it was possible to specify the concentration of any oil, independent of type, in a known water sample. In the final phases of the study, preliminary investigations on oil concentration determinations in bilge water were initiated."

FFI concerning conference proceedings contact Mary Ann Paturis, Marine Technology Society, 1730 M St. Northwest, Washington D.C., 20036

Sept. 13-24 Joint Oceanographic Assembly, Edinburgh, Scotland, 1976.

The Scientific Committee on Oceanic Research Symposium includes topics on the history of oceans, ocean circulation and marine life, natural variations in the marine environment, man and the sea, ocean engineering, minerals and petroleum, and others.

FFI contact The Organizing Committee, Joint Oceanographic Assembly 1976, c/o The Royal Society of Edinburgh, 22 George St., Edinburgh EH2 2PQ, Scotland, U.K.

Sept. 14-18 Aquatech '76 Exposition and Conference, Amsterdam, The Netherlands, 1976.

Aquatech '76 is one of the world's largest water equipment exhibitions and will include products and information on water purification and water pollution control equipment and technology.

FFI contact Mr. George Ruffner, U.S. Department of Commerce OIM/BIC, Room 1015, Washington, D.C. 20230

*Sept. 21-24 Offshore North Sea Technology Conference and Exhibition, 2nd, Stavanger, Norway, 1976.

FFI contact NOROIL Publishing House, Conference Department, P.O. Box 480, 4001 Stavanger, Norway

Sept. 21-25 IOPEC-International Oil Pollution Prevention Exhibition and Conference, 1st, Hamburg, Federal Republic of Germany, 1976.

IOPEC Exhibition will be held in conjunction with the International Ship, Machinery and Marine Technology Exhibition and Congress. The exhibition will focus on systems of prevention of oil and chemical pollution at sea and in coastal and inland waters. There will be products and information on the following subjects: research and development; consultation, expecially for land spills; absorbents, including absorbent booms; chemical dispersants; oil booms; spray systems; tank cleaning agents and equipment; vacuum trucks; special purpose trailers for booms and accessory equipment; skimmers ranging from small, portable units to large size units; special purpose craft, various types of pumps; oil-water separators; effluent monitors; spill detection and monitoring devices; training courses; and engineering support and services.

The IOPEC Conference (Sept. 24, 1976) will feature 8 papers that will analyze and discuss: (1) disasters in the open ocean such as collision at sea, oil rig and pipeline leaks (control would be primarily by spray techniques); and (2) control of coastal and inland waterways disasters by spray, boom and mechanical collection devices.

FFI contact IOPEC, Dorothy Mills, P.O. Box 428, South Norwalk, CT 06856

Sept. 27-
Oct. 1

International Ocean Development Exhibition, 4th, Tokyo, Japan, 1976.
Sponsored by the Japan Management Association.

The exhibition will include presentations on prevention and control of marine pollution.

FFI contact The Secretariat, International Ocean Development Conference and Exhibition, c/o Japan Management Association, 1-22 3-chrome, Shiba-Koen, Minato-Ku, Tokyo 105, Japan

Oct. 3-6

Canadian Chemical Engineering Conference, 26th, Toronto, Ontario, 1976.

The conference will include topics on energy sources, conservation in processing industries, and environmental aspects of wastewater treatment practices in the petroleum, petrochemical and other industries.

FFI contact E.H. Nenninger, Hatch Associates, 21 St. Clair East, Toronto, Ontario M4T 1L9, Canada

Oct. 3-8

Water Pollution Control Federation Conference, 49th, Minneapolis, Minnesota, 1976.

Topics to be covered include marine pollution and hazards, prevention and cleanup, large tankers and potential oil spills, and arctic transport of oil.

FFI contact Robert Canham, WPCF Executive Secretary, 3900 Wisconsin Ave., Washington, D.C. 20016

*Oct. 4-7

American Petroleum Institute, Refining Department Autumn Meeting, Chase Park Plaza, St. Louis, Missouri, 1976.

FFI contact the Refining Department, American Petroleum Institute, 2101 L St. Northwest, Washington, D.C. 20027

Oct. 17-22 International Conference of the International Association on Water Pollution Research, 8th, Sydney, Australia

Range of topics to be discussed include estuarine pollution surveys, pollution from oil and offshore materials resources development, and industrial wastes and petrochemicals. Workshop sessions will review progress and discuss current problems in water resource quality management, marine and estuarine waste disposal, ultimate disposal of solid and liquid wastes, and land surface and subsurface disposal of wastewaters.

Oil Pollution Related Papers

No. 15
SEDIMENTATION OF DISPERSED OIL IN SURFACE WATERS
Thuer, M., and W. Stumm

No. 48
MEASUREMENT AND TREATMENT OF OIL AND GREASE IN PETROLEUM AND PETROCHEMICAL INDUSTRIAL WASTEWATERS
Tischler, L.F., R.L. Elton, III, and D.L. Ford

No. 58
DEVELOPMENT OF A RAPID FISH TOXICITY TEST UTILIZAING A FREEZE CONCENTRATION TECHNIQUE FOR ROUTINE PETROLEUM REFINERY WASTEWATER MONITORING
Birchard, E.C.

FFI contact the Office of the Secretariat, Box 2609 G.P.O., Sydney, New South Wales 2001, Australia. Conference proceedings available from Pergamon Press, Oxford, England, U.K.

*Oct. 26-20 Antipollution '76, Milan, Italy, 1976.

FFI contact Presidence, Comis, Via Boccaccio 7, 20123 Milan, Italy

Nov. 2-4 Fate and Effects of Petroleum Hydrocarbons in Marine Ecosystems and Organisms, Seattle, Washington, 1976.
Sponsored by the U.S. Environmental Protection Agency, and NOAA's Outer Continental Shelf Environmental Assessment Program.

The symposium will focus on the distribution and effects of petroleum hydrocarbons in marine ecosystems, especially in the cold-water regimes of arctic to subarctic latitudes. Papers will be presented on physical distribution and transport of petroleum in the marine environment, biological accumulation, turnover and metabolism of petroleum hydrocarbons by marine organisms, and acute toxicity and sublethal effects of petroleum exposure to marine organisms.

FFI contact D.A. Wolfe, Symposium Coordinator, NOAA OCS Environmental Assessment Program, Rx4, Boulder, CO 80302

*Nov. 9-11 International Pollution and Engineering Exposition and Congress, 5th, Anaheim Convention Center, California, 1976.

This will be the first major exhibition and congress in the environmental field to be produced on the West Coast.

FFI contact Clapp and Poliak, Inc., 245 Park Ave., New York, NY 10017

*Nov. 15-20 Environmental Pollution Control Exhibition 1976 (ENPOCON), National Exhibition Center, Birmingham, U.K., 1976.

FFI contact Howard Phillips, Brintex Exhibitions Ltd., 178-202 Great Portland St., London WIN 6NH, England

*Nov. 24-26 Coastal Society, Conference, 1st, Washington, D.C., 1976.

The topic of the conference will be outer continental shelf oil leasing policies.

FFI contact the Coastal Society, P.O. Box 34405, Bethesda, MD 20034

March 8-10 1977 Conference on the Prevention, Behavior, Control and Cleanup of Oil Pollution, 5th, New Orleans, 1977.
Jointly sponsored by the American Petroleum Institute, U.S. Environmental Protection Agency, and U.S. Coast Guard.

The conference will feature 90 papers which stress training procedures, operational case histories, pollution prevention, and the development of new techniques for use in inland, coastal, deepwater, and arctic oil spill control operations.

FFI contact Dr. Charles C. Bates, Program Chairman-1977 Oil Spill Conference, U.S. Coast Guard (G-DS/62, TRANSPOINT), Washington, D.C. 20590

MASTER LIST OF KEYWORDS

S: See
SA: See also

Absorption
Activated sludge
Adriatic Sea
Adsorption
Aegean Sea
Africa
Alaska
Alaska coast
Alaska, Gulf of
Algae . . . . .SA:Phytoplankton
Analytical techniques . . . . . SA: Chemical analysis; Source identification
Annelids
Antarctica
Arabian Sea
Arctic
Arctic Ocean
Argentina
Aromatic hydrocarbons . . . . . SA: SA:Hydrocarcons
Asia
Atlantic coast
Atlantic Ocean
Australia
Bacteria
Bahamas
Ballast
Baltic Sea
Bantry Bay
Beaches
Beaufort Sea
Bengal, Bay of
Benthos
Bering Sea
Bibliographies
Bilges
Biodegradation
Biological effects. . . . . SA:Toxicity
Biomass
Birds
Biscay, Bay of
Black Sea
Blowout prevention
Booms
Brazil
California
California coast
Canada
Carcinogens . . . . . SA:Health hazards; Aromatic hydrocarbons
Carribean Sea
Caspian Sea
Chedabucto Bay
Chemical analysis . . . . . SA: Analytical techniques; Source identification
Chemical effects
Chesapeake Bay
Chile
China
Chromatography
Cleanup . . . . . SA:Recovery; Containment
Coagulation
Coalescence
Coasts
Connecticut
Conservation
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C-1692-76	BIODEGRADATION, HYDROCARBONS, MICROORGANISMS, POLLUTION PREVENTION, TOXICITY,
C-1697-76	BIODEGRADATION, HYDROCARBONS, EVAPORATION, WEATHERING, *DISSOLUTION, *OCEAN WATERS,
C-1703-76	BIODEGRADATION, HYDROCARBONS, ANALYTICAL TECHNIQUES, WEATHERING, ENVIRONMENTAL EFFECTS,
C-1705-76	BIODEGRADATION, OIL SPILLS, INLAND, TOXICITY,
C-1713-76	BIODEGRADATION, DECOMPOSITION, HYDROCARBONS,
C-1738-76	BIODEGRADATION, BIBLIOGRAPHIES, DECOMPOSITION, OIL SPILLS, CLEANUP,
C-1239-76	BIOLOGICAL EFFECTS, OIL SPILLS, BIRDS, CHESAPEAKE BAY,
C-1243-76	BIOLOGICAL EFFECTS, OFFSHORE-EXPLORATION, PHYSICAL EFFECTS, FISHERIES,
C-1248-76	BIOLOGICAL EFFECTS, OIL SPILLS, METULA OIL SPILL, BIRDS, SHORELINES,
C-1264-76	BIOLOGICAL EFFECTS, MONITORING, MARINE ORGANISMS, OIL SPILLS, BEAUFORT SEA,
C-1271-76	BIOLOGICAL EFFECTS, MONITORING, OIL SLICKS, MOLLUSKS, *MACOMA BALTHICA,
C-1296-76	BIOLOGICAL EFFECTS, ANALYTICAL TECHNIQUES, HYDROCARBONS, MARINE ORGANISMS, OFFSHORE-PRODUCTION,
C-1389-76	BIOLOGICAL EFFECTS, EMULSIFIERS, MICROORGANISMS, *BENTHIC DIATOMS,
C-1568-76	BIOLOGICAL EFFECTS, MICROORGANISMS, PLANTS, SOIL, CRUDE OIL, FUEL OIL,

C-1569-76	BIOLOGICAL EFFECTS, CRUDE OIL, MARINE ORGANISMS,
C-1571-76	BIOLOGICAL EFFECTS, FUEL OIL, MOLLUSKS,
C-1572-76	BIOLOGICAL EFFECTS, BIRDS,
C-1575-76	BIOLOGICAL EFFECTS, HEALTH HAZARDS, *ORGANIC POLLUTANTS,
C-1577-76	BIOLOGICAL EFFECTS, OIL SPILLS, BIRDS, CONTINGENCY PLANNING, PERSONNEL TRAINING,
C-1578-76	BIOLOGICAL EFFECTS, OIL SPILLS, PLANTS, ALGAE,
C-1579-76	BIOLOGICAL EFFECTS, CRUDE OIL, DISPERSANTS, FISHES, *BALTIC HERRING,
C-1581-76	BIOLOGICAL EFFECTS, CRUDE OIL, ALGAE,
C-1582-76	BIOLOGICAL EFFECTS, PETROCHEMICALS, SOIL, MICROORGANISMS, PLANTS,
C-1583-76	BIOLOGICAL EFFECTS, HYDROCARBONS, FUEL OIL, FISHES, *GIRELLA PUNCTATA, *EELS (ANGULLA ROSTRADA),
C-1584-76	BIOLOGICAL EFFECTS, CRUDE OIL, FUEL OIL, PHYTOPLANKTON, ALGAE,
C-1585-76	BIOLOGICAL EFFECTS, OIL SPILLS, OIL WELLS, BIRDS,
C-1588-76	BIOLOGICAL EFFECTS, CRUDE OIL, CONTAMINATION, INVERTEBRATES, RIVERS, *OIL-TREATED SUBSTRATES,
C-1589-76	BIOLOGICAL EFFECTS, HEALTH HAZARDS, CRUDE OIL, HYDROCARBONS, AROMATIC HYDROCARBONS ,
C-1590-76	BIOLOGICAL EFFECTS, HEALTH HAZARDS, CRUDE OIL, HYDROCARBONS, AROMATIC HYDROCARBONS ,
C-1591-76	BIOLOGICAL EFFECTS, CRUDE OIL, *NAPHTHALENE, FRESHWATER, ALGAE, *CHLAMYDOMONAS ANGULOSA,
C-1593-76	BIOLOGICAL EFFECTS, OIL SPILLS, WASTEWATER, REFINERIES, MOLLUSKS, KOREA, SOUTH,
C-1598-76	BIOLOGICAL EFFECTS, ENVIRONMENTAL EFFECTS, CORAL REEFS, *MANGROVES, *SEA GRASS ECOSYSTEMS,
C-1604-76	BIOLOGICAL EFFECTS, PHYSICAL EFFECTS, OIL SPILLS, COASTS, BEAUFORT SEA, *GEOLOGIC STUDIES,
C-1606-76	BIOLOGICAL EFFECTS, TOXICITY, HYDROCARBONS, AROMATIC HYDROCARBONS , BIBLIOGRAPHIES,
C-1608-76	BIOLOGICAL EFFECTS, ENVIRONMENTAL EFFECTS, PETROCHEMICALS, WASTEWATER DISPOSAL , PRODUCTION, MARINE ORGANISMS, SANTA BARBARA CHANNEL,
C-1613-76	BIOLOGICAL EFFECTS, OIL SHALE DEVELOPMENT, WILDLIFE,
C-1614-76	BIOLOGICAL EFFECTS, OFFSHORE-DEVELOPMENT, LOUISIANA, MARINE ORGANISMS, FISHERIES, ECONOMIC EFFECTS, ENVIRONMENTAL MANAGEMENT, DRILLING, OIL SPILLS, BEAUFORT SEA, CANADA,
C-1703-76	HYDROCARBONS, ANALYTICAL TECHNIQUES, BIODEGRADATION, WEATHERING, ENVIRONMENTAL EFFECTS,
C-1708-76	BIOLOGICAL EFFECTS, MONITORING, ENVIRONMENTAL EFFECTS, HYDROCARBONS,
C-1709-76	BIOLOGICAL EFFECTS, ENVIRONMENTAL EFFECTS, OIL SPILLS, MARINE ORGANISMS, SHORELINES,
C-1710-76	BIOLOGICAL EFFECTS, OIL SPILLS, MARINE ORGANISMS,
C-1739-76	BIOLOGICAL EFFECTS, BIBLIOGRAPHIES, OIL SPILLS, ENVIRONMENTAL EFFECTS
C-1239-76	BIRDS, OIL SPILLS, BIOLOGICAL EFFECTS, CHESAPEAKE BAY,
C-1248-76	BIRDS, BIOLOGICAL EFFECTS, OIL SPILLS, METULA OIL SPILL, SHORELINES,

C-1421-76	BIRDS, RESTORATION, *TREATMENT PROCEDURES,
C-1572-76	BIRDS, BIOLOGICAL EFFECTS,
C-1577-76	BIRDS, BIOLOGICAL EFFECTS, OIL SPILLS, CONTINGENCY PLANNING, PERSONNEL TRAINING,
C-1585-76	BIRDS, BIOLOGICAL EFFECTS, OIL SPILLS, OIL WELLS,
C-1451-76	BLOWOUT PREVENTION, DESIGN AND ENGINEERING, *RAMS,
C-1453-76	BLOWOUT PREVENTION, DESIGN AND ENGINEERING, OIL WELLS,
C-1454-76	BLOWOUT PREVENTION, DESIGN AND ENGINEERING, OIL WELLS, OFFSHORE-DRILLING,
C-1459-76	BLOWOUT PREVENTION, DESIGN AND ENGINEERING, *SHEAR RAMS,
C-1651-76	BLOWOUT PREVENTION, OFFSHORE-PRODUCTION, LEAKAGE, OIL WELLS,
C-1731-76	BLOWOUT PREVENTION, REGULATIONS, DRILLING, CANADA,
C-1318-76	BOOMS, CONTAINMENT, OIL SPILLS, WASTEWATER,
C-1319-76	BOOMS, CONTAINMENT, OIL SLICKS, DESIGN AND ENGINEERING,
C-1323-76	BOOMS, CONTAINMENT, DESIGN AND ENGINEERING,
C-1325-76	BOOMS, CONTAINMENT, OIL SLICKS, EMULSIONS,
C-1327-76	BOOMS, CONTAINMENT, OIL SPILLS, DESIGN AND ENGINEERING,
C-1328-76	BOOMS, CONTAINMENT, DESIGN AND ENGINEERING,
C-1330-76	BOOMS, CONTAINMENT, OIL SPILLS, DESIGN AND ENGINEERING,
C-1351-76	BOOMS, RECOVERY, OIL SPILLS, SKIMMERS,
C-1380-76	BOOMS, OIL SPILLS, CLEANUP, SKIMMERS, DISPERSANTS,
C-1396-76	BOOMS, RECOVERY, OIL SLICKS, DESIGN AND ENGINEERING,
C-1410-76	BOOMS, OIL SPILLS, RECOVERY, SKIMMERS, DESIGN AND ENGINEERING, *EQUIPMENT TESTING,
C-1428-76	CALIFORNIA, OIL TRANSPORT, OCS, OIL SPILLS,
C-1595-76	CALIFORNIA, OIL TRANSPORT, OIL SLICKS, ENVIRONMENTAL EFFECTS, OIL SPILLS, NEW YORK,
C-1272-76	CALIFORNIA COAST, MONITORING, HYDROCARBONS,
C-1406-76	CANADA, OIL SPILLS, POLLUTION PREVENTION, CLEANUP, RECOVERY,
C-1596-76	CANADA, ENVIRONMENTAL EFFECTS, OIL SPILLS, LAKES, ARCTIC, BIOLOGICAL EFFECTS,
C-1635-76	CANADA, ENVIRONMENTAL EFFECTS, PRODUCTION, TAR SANDS,
C-1643-76	CANADA, ENVIRONMENTAL PROTECTION, OFFSHORE-DRILLING, BIOLOGICAL EFFECTS, OIL SPILLS, BEAUFORT SEA,
C-1644-76	CANADA, OFFSHORE-EXPLORATION, POLLUTION PREVENTION, *LABRADOR,
C-1702-76	CANADA, ENVIRONMENTAL EFFECTS, PORTS, OIL SPILLS, BAHAMAS,
C-1731-76	CANADA, REGULATIONS, BLOWOUT PREVENTION, DRILLING,
C-1258-76	CHEMICAL ANALYSIS, MONITORING, MEDITERRANEAN SEA, SAMPLING, INTERNATIONAL AGREEMENTS,
C-1270-76	CHEMICAL ANALYSIS, MONITORING, MEXICO/GULF OF, NATURAL SEEPAGE, OFFSHORE-PRODUCTION, OIL DISCHARGES,
C-1284-76	CHEMICAL ANALYSIS, CHROMATOGRAPHY, SOURCE IDENTIFICATION, HYDROCARBONS,
C-1285-76	CHEMICAL ANALYSIS, SAMPLING, NATURAL SEEPAGE, OIL WELLS, ALASKA/GULF OF,
C-1286-76	CHEMICAL ANALYSIS, ANALYTICAL TECHNIQUES, SPECTROSCOPY, SOURCE IDENTIFICATION,
C-1287-76	CHEMICAL ANALYSIS, CHROMATOGRAPHY, SPECTROSCOPY, ANALYTICAL TECHNIQUES,

C-1288-76 CHEMICAL ANALYSIS, CHROMATOGRAPHY, ANALYTICAL TECHNIQUES,
C-1289-76 CHEMICAL ANALYSIS, HYDROCARBONS, ALASKA/GULF OF, CHROMATOGRAPHY, SPECTROMETRY, *BASELINE STUDIES,
C-1290-76 CHEMICAL ANALYSIS, HYDROCARBONS, FISHES,
C-1291-76 CHEMICAL ANALYSIS, ANALYTICAL TECHNIQUES, CHROMATOGRAPHY, HYDROCARBONS, SEDIMENTS,
C-1293-76 CHEMICAL ANALYSIS, HYDROCARBONS, WASTEWATER, CHROMATOGRAPHY,
C-1297-76 CHEMICAL ANALYSIS, HYDROCARBONS, SEDIMENTS, RIVERS, CHROMATOGRAPHY, SPECTROMETRY,
C-1300-76 CHEMICAL ANALYSIS, SOURCE IDENTIFICATION, OIL SPILLS, *INFRARED SPECTROPHOTOMETRY, *DISCRIMINANT ANALYSIS,
C-1301-76 CHEMICAL ANALYSIS, CRUDE OIL, SOLUBILITY,
C-1302-76 CHEMICAL ANALYSIS, CHROMATOGRAPHY, HYDROCARBONS, SEDIMENTS, SEAWATER, SAMPLING,
C-1305-76 CHEMICAL ANALYSIS, AROMATIC HYDROCARBONS , *AQUATIC SYSTEMS,
C-1306-76 CHEMICAL ANALYSIS, SAMPLING, SEDIMENTS, OIL SPILLS, CHESAPEAKE BAY,
C-1307-76 CHEMICAL ANALYSIS, HYDROCARBONS, MARINE ORGANISMS, CHROMATOGRAPHY, SPECTROMETRY,
C-1311-76 CHEMICAL ANALYSIS, SOURCE IDENTIFICATION, OIL SPILLS, FUEL OIL, SPECTROMETRY, CHROMATOGRAPHY,
C-1313-76 CHEMICAL ANALYSIS, SOURCE IDENITFICATION, OIL SPILLS, SPECTROSCOPY,
C-1314-76 CHEMICAL ANALYSIS, SOURCE IDENTIFICATION, CRUDE OIL, CHROMATOGRAPHY,
C-1315-76 CHEMICAL ANALYSIS, SOURCE IDENTIFICATION, OIL SPILLS, *FLUORIMETRY,
C-1316-76 CHEMICAL ANALYSIS, SOURCE IDENTIFICATION, CHROMATOGRAPHY, *ASPHALTS,
C-1611-76 CHEMICAL ANALYSIS, SEDIMENTS, HYDROCARBONS, COASTS, FRANCE,
C-1682-76 CHEMICAL ANALYSIS, BIODEGRADATION, HYDROCARBONS, BACTERIA, *HEXADECANE, JAPAN, *TOKYO BAY,
C-1688-76 CHEMICAL ANALYSIS, BIODEGRADATION, BACTERIA, SEDIMENTS, CHESAPEAKE BAY, HYDROCARBONS,
C-1707-76 CHEMICAL ANALYSIS, HYDROCARBONS, SEDIMENTS,
C-1695-76 CHEMICAL EFFECTS, PHYSICAL EFFECTS, DISPERSIONS, WEATHERING, CHEMICAL ANALYSIS, CRUDE OIL,
C-1239-76 CHESAPEAKE BAY, OIL SPILLS, BIOLOGICAL EFFECTS, BIRDS,
C-1306-76 CHESAPEAKE BAY, CHEMICAL ANALYSIS, SAMPLING, SEDIMENTS, OIL SPILLS,
C-1688-76 CHESAPEAKE BAY, BIODEGRADATION, BACTERIA, SEDIMENTS, CHEMICAL ANALYSIS, HYDROCARBONS,
C-1283-76 CHROMATOGRAPHY, ANALYTICAL TECHNIQUES, HYDROCARBONS, SOURCE IDENTIFICATION,
C-1284-76 CHROMATOGRAPHY, CHEMICAL ANALYSIS, SOURCE IDENTIFICATION, HYDROCARBONS,
C-1287-76 CHROMATOGRAPHY, CHEMICAL ANALYSIS, SPECTROSCOPY, ANALYTICAL TECHNIQUES,

C-1288-76	CHROMATOGRAPHY, CHEMICAL ANALYSIS, ANALYTICAL TECHNIQUES,
C-1289-76	CHROMATOGRAPHY, CHEMICAL ANALYSIS, HYDROCARBONS, ALASKA/GULF OF, SPECTROMETRY, *BASELINE STUDIES,,
C-1291-76	CHROMATOGRAPHY, CHEMICAL ANALYSIS, ANALYTICAL TECHNIQUES, HYDROCARBONS, SEDIMENTS,
C-1292-76	CHROMATOGRAPHY, ANALYTICAL TECHNIQUES, HYDROCARBONS, SOLVENTS, SPECTROSCOPY,
C-1293-76	CHROMATOGRAPHY, CHEMICAL ANALYSIS, HYDROCARBONS, WASTEWATER,
C-1294-76	CHROMATOGRAPHY, ANALYTICAL TECHNIQUES, HYDROCARBONS, CARCINOGENS,
C-1297-76	CHROMATOGRAPHY, CHEMICAL ANALYSIS, HYDROCARBONS, SEDIMENTS, RIVERS, SPECTROMETRY,
C-1298-76	CHROMATOGRAPHY, ANALYTICAL TECHNIQUES, SPECTROMETRY, HYDROCARBONS, RIVERS,
C-1299-76	CHROMATOGRAPHY, ANALYTICAL TECHNIQUES, HYDROCARBONS, DETECTION,
C-1302-76	CHROMATOGRAPHY, CHEMICAL ANALYSIS, HYDROCARBONS, SEDIMENTS, SEAWATER, SAMPLING,
C-1304-76	CHROMATOGRAPHY, ANALYTICAL TECHNIQUES, SPECTROMETRY, AROMATIC HYDROCARBONS , CARCINOGENS,
C-1307-76	CHROMATOGRAPHY, CHEMICAL ANALYSIS, HYDROCARBONS, MARINE ORGANISMS, SPECTROMETRY,
C-1308-76	CHROMATOGRAPHY, SOURCE IDENTIFICATION, OIL SPILLS, ANALYTICAL TECHNIQUES, SPECTROSCOPY, SAMPLING,
C-1311-76	CHROMATOGRAPHY, SOURCE IDENTIFICATION, OIL SPILLS, FUEL OIL, CHEMICAL ANALYSIS, SPECTROMETRY,
C-1314-76	CHROMATOGRAPHY, SOURCE IDENTIFICATION, CRUDE OIL, CHEMICAL ANALYSIS,
C-1316-76	CHROMATOGRAPHY, SOURCE IDENTIFICATION, CHEMICAL ANALYSIS, *ASPHALTS,
C-1317-76	CHROMATOGRAPHY, SOURCE IDENTIFICATION, FUELS, ANALYTICAL TECHNIQUES,
C-1246-76	CLEANUP, OIL SPILLS, NEW YORK,
C-1250-76	CLEANUP, OIL SPILLS, OIL TRANSPORT, PIPELINES, EUROPE,
C-1252-76	CLEANUP, OIL SPILLS, FUEL OIL, CONTINGENCY PLANNING, GREAT LAKES , *LAKE MICHIGAN, *HANNAH BARGE SPILL,
C-1331-76	CLEANUP, OIL SPILLS, *AGGLOMERATION,
C-1332-76	CLEANUP, OIL SPILLS, INLAND, CONTINGENCY PLANNING,
C-1333-76	CLEANUP, POLLUTION PREVENTION, OCS, ARCTIC, BIBLIOGRAPHIES,
C-1335-76	CLEANUP, OIL SPILLS, ABSORPTION, BIODEGRADATION, MICROORGANISMS,
C-1336-76	CLEANUP, OIL SPILLS, *PHOTOSENSITIZER CHEMICALS,
C-1338-76	CLEANUP, DISPERSANTS, PIPELINES, WASTEWATER TREATMENT,
C-1339-76	CLEANUP, OIL SPILLS, HARBORS, JAPAN,
C-1340-76	CLEANUP, OIL SPILLS, ARCTIC, DETECTION, DISPOSAL ,
C-1349-76	CLEANUP, OIL SPILLS, ABSORPTION,
C-1354-76	CLEANUP, SKIMMERS, RECOVERY, OIL SPILLS,
C-1355-76	CLEANUP, CONTAINMENT, OIL SLICKS, DESIGN AND ENGINEERING, *ENVIRONMENTAL TEST TANK,

C-1359-76	CLEANUP, OIL SPILLS, ABSORPTION, *OLEOPHILIC POLYURETHANE FOAMS,
C-1362-76	CLEANUP, SKIMMERS, DESIGN AND ENGINEERING, OIL SPILLS,
C-1363-76	CLEANUP, POLLUTION PREVENTION, INDUSTRIES, INTERNATIONAL AGREEMENTS,
C-1365-76	CLEANUP, DISPERSANTS, OIL SPILLS,
C-1372-76	CLEANUP, OIL SPILLS, RECOVERY, CONTINGENCY PLANNING,
C-1373-76	CLEANUP, DISPERSANTS, OIL SPILLS, OIL SLICKS, *DETERGENTS,
C-1380-76	CLEANUP, OIL SPILLS, BOOMS, SKIMMERS, DISPERSANTS,
C-1382-76	CLEANUP, ABSORPTION, OIL SPILLS, RECOVERY, *PEAT FIBERS,
C-1385-76	CLEANUP, OIL SPILLS, INLAND, ARCTIC, CONTINGENCY PLANNING, DISPOSAL ,
C-1387-76	CLEANUP, POLLUTION PREVENTION, GOVERNMENT AGENCIES, OIL SPILLS, RECOVERY, OIL DISCHARGES,
C-1388-76	CLEANUP, ADSORPTION, RECOVERY, *BAGASSE,
C-1391-76	CLEANUP, EMULSIFICATION, OIL SPILLS, TOXICITY, MARINE ORGANISMS,
C-1392-76	CLEANUP, OIL SPILLS, EMULSIFICATION, *DETERGENTS,
C-1395-76	CLEANUP, RECOVERY, OIL SPILLS, ABSORPTION, *COTTON WASTES,
C-1399-76	CLEANUP, OIL SPILLS, CRUDE OIL, ABSORPTION,
C-1400-76	CLEANUP, CRUDE OIL, DISPERSIONS, EMULSIONS,
C-1401-76	CLEANUP, OIL SPILLS, CONTAINMENT, *POLYMERIZATION,
C-1402-76	CLEANUP, OIL SLICKS, OIL SPILLS, ADSORPTION,
C-1403-76	CLEANUP, DESIGN AND ENGINEERING, RECOVERY, OIL SPILLS, *WAVE DAMPING,
C-1405-76	CLEANUP, OIL SPILLS, RECOVERY, DESIGN AND ENGINEERING,
C-1406-76	CLEANUP, OIL SPILLS, POLLUTION PREVENTION, RECOVERY, CANADA,
C-1407-76	CLEANUP, RECOVERY, MANUALS, DESIGN AND ENGINEERING,
C-1411-76	CLEANUP, RECOVERY, OIL SLICKS,
C-1342-76	CLEANUP, OIL SPILLS, RECOVERY, ABSORPTION,
C-1414-76	CLEANUP, OIL SPILLS, DESIGN AND ENGINEERING, OIL-WATER SEPARATION,
C-1416-76	CLEANUP, OIL SPILLS, POLLUTION PREVENTION, INDUSTRY, GOVERNMENT AGENCIES,
C-1417-76	CLEANUP, OIL SPILLS, CONTINGENCY PLANNING, INDUSTRIES,
C-1420-76	CLEANUP, RESTORATION, OIL SPILLS, SOIL, BIODEGRADATION,
C-1458-76	CLEANUP, DESIGN AND ENGINEERING, RECOVERY, OIL SPILLS,
C-1559-76	CLEANUP, PERSONNEL TRAINING, OIL SPILLS,
C-1560-76	CLEANUP, PERSONNEL TRAINING, POLLUTION PREVENTION, OIL SPILLS, CONTINGENCY PLANNING, REGULATIONS,
C-1561-76	CLEANUP, CONTINGENCY PLANNING, OIL SPILLS, ALASKA/GULF OF, PERSONNEL TRAINING, *PORT OF VALDEZ,
C-1564-76	CLEANUP, CONTINGENCY PLANNING, OIL SPILLS, INLAND, GUIDELINES,
C-1566-76	CLEANUP, CONTINGENCY PLANNING, OIL SPILLS, PERSONNEL TRAINING, DISPERSANTS,
C-1574-76	CLEANUP, OIL SPILLS, TOXICITY, CRUDE OIL, DISPERSANTS, CORAL REEFS,
C-1667-76	CLEANUP, BIODEGRADATION, OIL SPILLS, BACTERIA,

C-1700-76	CLEANUP, MOVEMENT, OIL SPILLS, BIBLIOGRAPHIES, SPREADING, DECOMPOSITION,
C-1736-76	CLEANUP, OIL SPILLS, INTERNATIONAL CONVENTIONS, ENVIRONMENTAL PROTECTION, *SAFETY STANDARDS,
C-1738-76	CLEANUP, BIBLIOGRAPHIES, BIODEGRADATION, DECOMPOSITION, OIL SPILLS,
C-1374-76	COAGULATION, WASTEWATER TREATMENT, OIL-WATER SEPARATION, EMULSIONS,
C-1419-76	COAGULATION, RECOVERY, OIL SPILLS, ABSORPTION,
C-1490-76	COAGULATION, WASTEWATER TREATMENT, REFINERIES, FLOCCULATION,
C-1475-76	COALESCENCE, WASTEWATER TREATMENT, OIL-WATER SEPARATION, EMULSIONS,
C-1479-76	COALESCENCE, WASTEWATER TREATMENT, EMULSIONS,
C-1487-76	COALESCENCE, OIL-WATER SEPARATION, SHIPS, DESIGN AND ENGINEERING,
C-1491-76	COALESCENCE, WASTEWATER TREATMENT, OIL-WATER SEPARATION, EMULSIONS,
C-1504-76	COALESCENCE, WASTEWATER TREATMENT, OIL-WATER SEPARATION, EMULSIONS,
C-1245-76	COASTS, OIL SLICKS, LEGISLATION, *NORTHWEST COAST,
C-1276-76	COASTS, REMOTE SENSING, MODELS, OIL SLICKS,
C-1604-76	COASTS, BIOLOGICAL EFFECTS, PHYSICAL EFFECTS, OIL SPILLS, BEAUFORT SEA, *GEOLOGIC STUDIES,
C-1611-76	COASTS, SEDIMENTS, CHEMICAL ANALYSIS, HYDROCARBONS, FRANCE,
C-1634-76	COASTS, LEGISLATION, OFFSHORE-DEVELOPMENT, ENVIRONMENTAL MANAGEMENT,
C-1647-76	COASTS, OCS, OFFSHORE-DEVELOPMENT, EIS, ENVIRONMENTAL EFFECTS, ESTUARIES,
C-1693-76	COASTS, SPREADING, OIL SLICKS,
C-1706-76	COASTS, OIL SLICKS, MOVEMENT, ESTUARIES, DELAWARE BAY,
C-1735-76	COASTS, GUIDELINES, POLLUTION PREVENTION, INDONESIA, BIBLIOGRAPHIES,
C-1663-76	CONSERVATION, OIL SHALE DEVELOPMENT, ENVIRONMENTAL MANAGEMENT, *ENDANGERED SPECIES,
C-1729-76	CONSERVATION, INTERNATIONAL CONVENTIONS, ENVIRONMENTAL PROTECTION,
C-1318-76	CONTAINMENT, BOOMS, OIL SPILLS, WASTEWATER,
C-1319-76	CONTAINMENT, BOOMS, OIL SLICKS, DESIGN AND ENGINEERING,
C-1320-76	CONTAINMENT, OIL SPILLS, HARBORS, OIL TRANSFER, *BUBBLE BARRIER,
C-1321-76	CONTAINMENT, OIL SPILLS, INLAND, DESIGN AND ENGINEERING, *TRANSFORMER COOLANT OIL,
C-1322-76	CONTAINMENT, OIL SPILLS,
C-1323-76	CONTAINMENT, BOOMS, DESIGN AND ENGINEERING,
C-1324-76	CONTAINMENT, OIL SLICKS, DESIGN AND ENGINEERING, *OIL SCREEN,
C-1325-76	CONTAINMENT, BOOMS, OIL SLICKS, EMULSIONS,
C-1326-76	CONTAINMENT, OIL SLICKS, CRUDE OIL, *OIL HERDERS,
C-1327-76	CONTAINMENT, OIL SPILLS, BOOMS, DESIGN AND ENGINEERING,
C-1328-76	CONTAINMENT, BOOMS, DESIGN AND ENGINEERING,

C-1329-76 CONTAINMENT, OIL SLICKS, DESIGN AND ENGINEERING,
C-1330-76 CONTAINMENT, BOOMS, OIL SPILLS, DESIGN AND ENGINEERING,
C-1350-76 CONTAINMENT, OIL SPILLS, RECOVERY, DESIGN AND ENGINEERING,
C-1355-76 CONTAINMENT, CLEANUP, OIL SLICKS, DESIGN AND ENGINEERING, *ENVIRONMENTAL TEST TANK,
C-1361-76 CONTAINMENT, RECOVERY, OIL SLICKS, DESIGN AND ENGINEERING,
C-1401-76 CONTAINMENT, CLEANUP, OIL SPILLS, *POLYMERIZATION,
C-1413-76 CONTAINMENT, RECOVERY, OIL SPILLS, STREAMS, HARBORS,
C-1607-76 CONTAMINANTS, ENVIRONMENTAL EFFECTS, HYDROCARBONS, CRUDE OIL, ALASKA COAST,
C-1261-76 CONTAMINATION, MONITORING, CARCINOGENS, MOLLUSKS, *BENZO(A)PYRENE,
C-1262-76 CONTAMINATION, MONITORING, GROUNDWATER, DETECTION, SAMPLING,
C-1263-76 CONTAMINATION, MONITORING, DETECTION, WASTEWATER, *FLUORESCENCE, *IR AND UV LIGHT MEASUREMENT,
C-1265-76 CONTAMINATION, MONITORING, LEAKAGE, OFFSHORE-DRILLING, DESIGN AND ENGINEERING,
C-1588-76 CONTAMINATION, BIOLOGICAL EFFECTS, CRUDE OIL, INVERTEBRATES, RIVERS, *OIL-TREATED SUBSTRATES,
C-1609-76 CONTAMINATION, FUEL OIL, ENVIRONMENTAL EFFECTS, DECOMPOSITION, TOXICITY,
C-1661-76 CONTAMINATION, ENVIRONMENTAL EFFECTS, OIL SHALE DEVELOPMENT, GROUNDWATER, *COLORADO RIVER,
C-1664-76 CONTAMINATION, DRILLING, TEXAS, *FRESHWATER AQUIFER,
C-1716-76 CONTAMINATION, LEGISLATION, GROUNDWATER, DRILLING, WATER QUALITY,
C-1252-76 CONTINGENCY PLANNING, OIL SPILLS, FUEL OIL, CLEANUP, GREAT LAKES , *LAKE MICHIGAN, *HANNAH BARGE SPILL,
C-1332-76 CONTINGENCY PLANNING, CLEANUP, OIL SPILLS, INLAND,
C-1372-76 CONTINGENCY PLANNING, OIL SPILLS, CLEANUP, RECOVERY,
C-1385-76 CONTINGENCY PLANNING, OIL SPILLS, INLAND, ARCTIC, CLEANUP, DISPOSAL ,
C-1417-76 CONTINGENCY PLANNING, CLEANUP, OIL SPILLS, INDUSTRIES,
C-1560-76 CONTINGENCY PLANNING, PERSONNEL TRAINING, POLLUTION PREVENTION, OIL SPILLS, CLEANUP, REGULATIONS,
C-1561-76 CONTINGENCY PLANNING, OIL SPILLS, ALASKA/GULF OF, PERSONNEL TRAINING, CLEANUP, *PORT OF VALDEZ,
C-1562-76 CONTINGENCY PLANNING, OIL SPILLS, POLLUTION PREVENTION, GOVERNMENT AGENCIES,
C-1563-76 CONTINGENCY PLANNING, OIL SPILLS, POLLUTION PREVENTION, PERSONNEL TRAINING,
C-1564-76 CONTINGENCY PLANNING, OIL SPILLS, INLAND, GUIDELINES, CLEANUP,
C-1565-76 CONTINGENCY PLANNING, OIL SPILLS, INLAND, GREAT LAKES ,
C-1566-76 CONTINGENCY PLANNING, OIL SPILLS, PERSONNEL TRAINING, CLEANUP, DISPERSANTS,
C-1567-76 CONTINGENCY PLANNING, PERSONNEL TRAINING, OIL TRANSPORT, OIL DISCHARGES,
C-1577-76 CONTINGENCY PLANNING, BIOLOGICAL EFFECTS, OIL SPILLS, BIRDS, PERSONNEL TRAINING,

C-1712-76	CONTINGENCY PLANNING, MODELS, OIL SPILLS, NORTH SEA,
C-1551-76	CRANKCASE OIL, WASTE OIL TREATMENT, RECLAMATION, LUBRICATING OIL, FUEL OIL,
C-1552-76	CRANKCASE OIL, WASTE OIL TREATMENT, RECLAMATION,
C-1558-76	CRANKCASE OIL, RECLAMATION, RECYCLING, *PYROLIZATION,
C-1676-76	CRANKCASE OIL, BIODEGRADATION, REGULATIONS, EMULSIFICATION, WATER QUALITY,
C-1281-76	CRUDE OIL, SAMPLING, OIL-WATER SEPARATION, *CENTRIFUGATION,
C-1295-76	CRUDE OIL, ANALYTICAL TECHNIQUES, FUEL OIL, SPECTROMETRY, *INFRARED SPECTROPHOTOMETRY,
C-1301-76	CRUDE OIL, SOLUBILITY, CHEMICAL ANALYSIS,
C-1314-76	CRUDE OIL, SOURCE IDENTIFICATION, CHEMICAL ANALYSIS, CHROMATOGRAPHY,
C-1326-76	CRUDE OIL, CONTAINMENT, OIL SLICKS, *OIL HERDERS,
C-1399-76	CRUDE OIL, CLEANUP, OIL SPILLS, ABSORPTION,
C-1400-76	CRUDE OIL, CLEANUP, DISPERSIONS, EMULSIONS,
C-1439-76	CRUDE OIL, STORAGE, ENVIRONMENTAL PROTECTION, *SALT DOMES,
C-1446-76	CRUDE OIL, OIL TRANSPORT, TANKERS, ENVIRONMENTAL PROTECTION,
C-1537-76	CRUDE OIL, WASTEWATER TREATMENT, OIL-WATER SEPARATION, HYDROCARBONS, *POLYETHYLENE POWDER,
C-1544-76	CRUDE OIL, WASTE OIL TREATMENT, RECLAMATION, SOLID WASTE, *PYROLYSIS,
C-1548-76	CRUDE OIL, RECLAMATION, EXTRACTION, *FLEXICOKING, *RESIDUAL OILS,
C-1568-76	CRUDE OIL, BIOLOGICAL EFFECTS, MICROORGANISMS, PLANTS, SOIL, FUEL OIL,
C-1569-76	CRUDE OIL, BIOLOGICAL EFFECTS, MARINE ORGANISMS,
C-1574-76	CRUDE OIL, CLEANUP, OIL SPILLS, TOXICITY, DISPERSANTS, CORAL REEFS,
C-1576-76	CRUDE OIL, TOXICITY, DISPERSANTS, FISH, INVERTEBRATES, RED SEA,
C-1579-76	CRUDE OIL, BIOLOGICAL EFFECTS, DISPERSANTS, FISHES, *BALTIC HERRING,
C-1581-76	CRUDE OIL, BIOLOGICAL EFFECTS, ALGAE,
C-1584-76	CRUDE OIL, FUEL OIL, BIOLOGICAL EFFECTS, PHYTOPLANKTON, ALGAE,
C-1586-76	CRUDE OIL, TOXICITY, FUEL OIL, ANNELIDS, *NEANTHES ARENACEODENTATA,
C-1588-76	CRUDE OIL, BIOLOGICAL EFFECTS, CONTAMINATION, INVERTEBRATES, RIVERS, *OIL-TREATED SUBSTRATES,
C-1589-76	CRUDE OIL, BIOLOGICAL EFFECTS, HEALTH HAZARDS, HYDROCARBONS, AROMATIC HYDROCARBONS ,
C-1590-76	CRUDE OIL, BIOLOGICAL EFFECTS, HEALTH HAZARDS, HYDROCARBONS, AROMATIC HYDROCARBONS ,
C-1591-76	CRUDE OIL, BIOLOGICAL EFFECTS, *NAPHTHALENE, FRESHWATER, ALGAE, *CHLAMYDOMONAS ANGULOSA,
C-1592-76	CRUDE OIL, TOXICITY, HYDROCARBONS, CRUSTACEANS, *NAPHTHALENE, *GRASS SHRIMP,
C-1605-76	CRUDE OIL, ENVIRONMENTAL EFFECTS, SEDIMENTS, JAPAN,

C-1607-76 CRUDE OIL, ENVIRONMENTAL EFFECTS, CONTAMINANTS, HYDROCARBONS, ALASKA COAST,
C-1668-76 CRUDE OIL, BIODEGRADATION, ARCTIC, TOXICITY,
C-1671-76 CRUDE OIL, BIODEGRADATION, BACTERIA, RIVERS, SEDIMENT, *ACINETOBACTER,
C-1672-76 CRUDE OIL, BIODEGRADATION, OXIDATION, HYDROCARBONS, FUNGI, BACTERIA,
C-1690-76 CRUDE OIL, BIODEGRADATION, FUEL OIL, BACTERIA,
C-1695-76 CRUDE OIL, CHEMICAL EFFECTS, PHYSICAL EFFECTS, DISPERSIONS, WEATHERING, CHEMICAL ANALYSIS,
C-1592-76 CRUSTACEANS, TOXICITY, CRUDE OIL, HYDROCARBONS, *NAPHTHALENE, *GRASS SHRIMP,
C-1699-76 CRUSTACEANS, HYDROCARBONS, FOOD WEB, *CALANUS HELGOLANDICUS CLAUS, *NAPHTHALENE, *DEPURATION,
C-1609-76 DECOMPOSITION, FUEL OIL, CONTAMINATION, ENVIRONMENTAL EFFECTS, TOXICITY,
C-1696-76 DECOMPOSITION, SEDIMENTS, *ANAEROBIC CONDITIONS,
C-1700-76 DECOMPOSITION, MOVEMENT, OIL SPILLS, BIBLIOGRAPHIES, SPREADING, CLEANUP,
C-1713-76 DECOMPOSITION, BIODEGRADATION, HYDROCARBONS,
C-1714-76 DECOMPOSITION, OIL SPILLS, FUEL OIL, WEATHERING, SOIL,
C-1738-76 DECOMPOSITION, BIBLIOGRAPHIES, BIODEGRADATION, OIL SPILLS, CLEANUP,
C-1275-76 DELAWARE, REMOTE SENSING, OIL SLICKS, ESTUARIES,
C-1659-76 DELAWARE, EIS, OFFSHORE-DEVELOPMENT, OCS, NEW JERSEY, ENVIRONMENTAL EFFECTS, OIL-GAS LEASING,
C-1711-76 DELAWARE, MODELS, OIL SLICKS, MOVEMENT, ATLANTIC COAST, NEW JERSEY,
C-1706-76 DELAWARE BAY, OIL SLICKS, MOVEMENT, ESTUARIES, COASTS,
C-1253-76 DESIGN AND ENGINEERING, MONITORING, POLLUTION PREVENTION, INTERNATIONAL CONVENTIONS,
C-1265-76 DESIGN AND ENGINEERING, MONITORING, CONTAMINATION, LEAKAGE, OFFSHORE-DRILLING,
C-1266-76 DESIGN AND ENGINEERING, MONITORING, DETECTION, OIL SPILLS, *OIL SENSOR,
C-1273-76 DESIGN AND ENGINEERING, REMOTE SENSING, OIL SLICKS,
C-1321-76 DESIGN AND ENGINEERING, CONTAINMENT, OIL SPILLS, INLAND, *TRANSFORMER COOLANT OIL,
C-1323-76 DESIGN AND ENGINEERING, CONTAINMENT, BOOMS,
C-1324-76 DESIGN AND ENGINEERING, CONTAINMENT, OIL SLICKS, *OIL SCREEN,
C-1327-76 DESIGN AND ENGINEERING, CONTAINMENT, OIL SPILLS, BOOMS,
C-1328-76 DESIGN AND ENGINEERING, CONTAINMENT, BOOMS,
C-1329-76 DESIGN AND ENGINEERING, CONTAINMENT, OIL SLICKS,
C-1330-76 DESIGN AND ENGINEERING, CONTAINMENT, BOOMS, OIL SPILLS,
C-1337-76 DESIGN AND ENGINEERING, RECOVERY, OIL SPILLS, ABSORPTION,
C-1342-76 DESIGN AND ENGINEERING, OIL SPILLS, RECOVERY, SKIMMERS, BEAUFORT SEA,
C-1344-76 DESIGN AND ENGINEERING, RECOVERY, OIL SPILLS, ABSORPTION,
C-1348-76 DESIGN AND ENGINEERING, SKIMMERS, RECOVERY, OIL SPILLS,

C-1350-76	DESIGN AND ENGINEERING, OIL SPILLS, RECOVERY, CONTAINMENT,
C-1352-76	DESIGN AND ENGINEERING, OIL SPILLS, RECOVERY,
C-1353-76	DESIGN AND ENGINEERING, OIL SPILLS, RECOVERY,
C-1355-76	DESIGN AND ENGINEERING, CLEANUP, CONTAINMENT, OIL SLICKS, *ENVIRONMENTAL TEST TANK,
C-1357-76	DESIGN AND ENGINEERING, RECOVERY, OIL SPILLS, SKIMMERS, PUGET SOUND,
C-1360-76	DESIGN AND ENGINEERING, RECOVERY, OIL SPILLS,
C-1361-76	DESIGN AND ENGINEERING, CONTAINMENT, RECOVERY, OIL SLICKS,
C-1362-76	DESIGN AND ENGINEERING, SKIMMERS, CLEANUP, OIL SPILLS,
C-1366-76	DESIGN AND ENGINEERING, RECOVERY, OIL SPILLS, OIL SLICKS,
C-1368-76	DESIGN AND ENGINEERING, RECOVERY, OIL SPILLS, SKIMMERS,
C-1369-76	DESIGN AND ENGINEERING, RECOVERY, OIL SPILLS,
C-1370-76	DESIGN AND ENGINEERING, RECOVERY, OIL SPILLS, SKIMMERS,
C-1375-76	DESIGN AND ENGINEERING, RECOVERY, SKIMMERS,
C-1376-76	DESIGN AND ENGINEERING, SKIMMERS, RECOVERY, OIL SLICKS,
C-1377-76	DESIGN AND ENGINEERING, RECOVERY, OIL SLICKS, SKIMMERS,
C-1378-76	DESIGN AND ENGINEERING, RECOVERY, OIL SLICKS, *OIL COLLECTOR,
C-1383-76	DESIGN AND ENGINEERING, RECOVERY, OIL SPILLS, *EQUIPMENT TESTING,
C-1384-76	DESIGN AND ENGINEERING, RECOVERY, OIL SPILLS, SKIMMERS, *EQUIPMENT TESTING,
C-1386-76	DESIGN AND ENGINEERING, RECOVERY, OIL SLICKS, *OLEOPHILIC DISCS,
C-1394-76	DESIGN AND ENGINEERING. RECOVERY, OIL SLICKS, SKIMMERS,
C-1396-76	DESIGN AND ENGINEERING, RECOVERY, OIL SLICKS, BOOMS,
C-1397-76	DESIGN AND ENGINEERING, RECOVERY, OIL SPILLS, SKIMMERS,
C-1403-76	DESIGN AND ENGINEERING, CLEANUP, RECOVERY, OIL SPILLS, *WAVE DAMPING,
C-1404-76	DESIGN AND ENGINEERING, RECOVERY, NATURAL SEEPAGE,
C-1405-76	DESIGN AND ENGINEERING, OIL SPILLS, CLEANUP, RECOVERY,
C-1407-76	DESIGN AND ENGINEERING, CLEANUP, RECOVERY, MANUALS,
C-1408-76	DESIGN AND ENGINEERING, RECOVERY, OIL SPILLS, *U.S. COAST GUARD,
C-1409-76	DESIGN AND ENGINEERING, RECOVERY, OIL SPILLS,
C-1410-76	DESIGN AND ENGINEERING, OIL SPILLS, RECOVERY, SKIMMERS, BOOMS, *EQUIPMENT TESTING,
C-1414-76	DESIGN AND ENGINEERING, CLEANUP, OIL SPILLS, OIL-WATER SEPARATION,
C-1418-76	DESIGN AND ENGINEERING, OIL SLICKS, SKIMMERS, OIL-WATER SEPARATION,
C-1424-76	DESIGN AND ENGINEERING, EIS, REGULATIONS, TANKERS, POLLUTION PREVENTION,
C-1431-76	DESIGN AND ENGINEERING, OIL TRANSPORT, TANKERS,
C-1436-76	DESIGN AND ENGINEERING, OIL TRANSPORT, TANKERS, INLAND, POLLUTION PREVENTION,
C-1440-76	DESIGN AND ENGINEERING, OIL TRANSFER, TANKERS, PORTS, POLLUTION PREVENTION,

C-1441-76	DESIGN AND ENGINEERING, TANKERS, OIL TRANSPORT, OIL SPILLS, POLLUTION PREVENTION,
C-1443-76	DESIGN AND ENGINEERING, OFFSHORE-PIPELINES, LEAKAGE,
C-1447-76	DESIGN AND ENGINEERING, MANUALS, GUIDELINES, OIL SPILLS, WASTE OIL DISPOSAL , WASTEWATER TREATMENT,
C-1448-76	DESIGN AND ENGINEERING, MANUALS, OIL SPILLS, WASTEWATER TREATMENT, BILGES, EIS,
C-1449-76	DESIGN AND ENGINEERING, TANKERS, SEGREGATED BALLAST ,
C-1450-76	DESIGN AND ENGINEERING, OFFSHORE-DRILLING, TOXICITY, *DRILLING FLUID, ENVIRONMENTAL PROTECTION,
C-1451-76	DESIGN AND ENGINEERING, BLOWOUT PREVENTION, *RAMS,
C-1452-76	DESIGN AND ENGINEERING, POLLUTION PREVENTION, BALLAST, OIL-WATER SEPARATION,
C-1453-76	DESIGN AND ENGINEERING, BLOWOUT PREVENTION, OIL WELLS,
C-1454-76	DESIGN AND ENGINEERING, BLOWOUT PREVENTION, OIL WELLS, OFFSHORE-DRILLING,
C-1455-76	DESIGN AND ENGINEERING, REFINERIES, ECONOMIC EFFECTS, REGULATIIONS,
C-1456-76	DESIGN AND ENGINEERING, OIL-WATER SEPARATION, EXPLORATION, OIL SPILLS,
C-1458-76	DESIGN AND ENGINEERING, CLEANUP, RECOVERY, OIL SPILLS,
C-1459-76	DESIGN AND ENGINEERING, BLOWOUT PREVENTION, *SHEAR RAMS,
C-1468-76	DESIGN AND ENGINEERING, WASTEWATER TREATMENT, SHIPS, BILGES,
C-1471-76	DESIGN AND ENGINEERING, OIL-WATER SEPARATION, WASTEWATER TREATMENT, ADSORPTION,
C-1474-76	DESIGN AND ENGINEERING, WASTE OIL DISPOSAL , SHIPS, INCINERATION,
C-1480-76	DESIGN AND ENGINEERING, WASTEWATER TREATMENT, SHIPS, BILGES, BALLAST,
C-1487-76	DESIGN AND ENGINEERING, OIL-WATER SEPARATION, SHIPS, COALESCENCE,
C-1506-76	DESIGN AND ENGINEERING, REFINERIES, WASTEWATER TREATMENT, FILTRATION, ADSORPTION, WATER SEPARATION, FLOCCULATION, FILTRATION,
C-1513-76	DESIGN AND ENGINEERING, *WELL CUTTINGS DISPOSAL , OFFSHORE-DRILLING, OIL-WATER SEPARATION,
C-1516-76	DESIGN AND ENGINEERING, WASTEWATER TREATMENT, OIL-WATER SEPARATION,
C-1521-76	DESIGN AND ENGINEERING, REFINERIES, WASTEWATER TREATMENT, ADSORPTION,
C-1528-76	DESIGN AND ENGINEERING, WASTEWATER TREATMENT, OIL-WATER SEPARATION, ABSORPTION,
C-1534-76	DESIGN AND ENGINEERING, WASTEWATER TREATMENT, WASTE OIL TREATMENT, PRODUCTION, MEXICO/GULF OF, POLLUTION PREVENTION,
C-1733-76	GUIDELINES, GERMANY, WEST, POLLUTION PREVENTION, REGULATIONS, PERSONNEL TRAINING,
C-1254-76	DETECTION, MONITORING, OIL DISCHARGES, SHIPS, BALLAST,
C-1256-76	DETECTION, MONITORING, OIL SPILLS, *OIL SENSOR, *OLEOPHILIC MEMBRANE,
C-1262-76	DETECTION, MONITORING, GROUNDWATER, CONTAMINATION, SAMPLING,

C-1263-76 DETECTION, MONITORING, CONTAMINATION, WASTEWATER, *FLUORESCENCE, *IR AND UV LIGHT MEASUREMENT,
C-1266-76 DETECTION, MONITORING, OIL SPILLS, DESIGN AND ENGINEERING, *OIL SENSOR,
C-1274-76 DETECTION, REMOTE SENSING, MONITORING, OIL SPILLS,
C-1284-76 CHEMICAL ANALYSIS, CHROMATOGRAPHY, SOURCE IDENTIFICATION, HYDROCARBONS,
C-1299-76 DETECTION, ANALYTICAL TECHNIQUES, CHROMATOGRAPHY, HYDROCARBONS,
C-1340-76 DETECTION, OIL SPILLS, ARCTIC, CLEANUP, DISPOSAL ,
C-1338-76 DISPERSANTS, CLEANUP, PIPELINES, WASTEWATER TREATMENT,
C-1365-76 DISPERSANTS, CLEANUP, OIL SPILLS,
C-1373-76 DISPERSANTS, CLEANUP, OIL SPILLS, OIL SLICKS, *DETERGENTS,
C-1380-76 DISPERSANTS, OIL SPILLS, CLEANUP, BOOMS, SKIMMERS,
C-1398-76 DISPERSANTS, OIL SPILLS, *SAFETY,
C-1566-76 DISPERSANTS, CONTINGENCY PLANNING, OIL SPILLS, PERSONNEL TRAINING, CLEANUP,
C-1574-76 DISPERSANTS, CLEANUP, OIL SPILLS, TOXICITY, CRUDE OIL, CORAL REEFS,
C-1576-76 DISPERSANTS, TOXICITY, CRUDE OIL, FISH, INVERTEBRATES, RED SEA,
C-1579-76 DISPERSANTS, BIOLOGICAL EFFECTS, CRUDE OIL, FISHES, *BALTIC HERRING,
C-1390-76 DISPERSIONS, OIL SPILLS, BIODEGRADATION, SURFACTANTS, *ILLUMINATION,
C-1400-76 DISPERSIONS, CLEANUP, CRUDE OIL, EMULSIONS,
C-1473-76 DISPERSIONS, WASTE OIL DISPOSAL, PETROCHEMICALS,
C-1695-76 DISPERSIONS, CHEMICAL EFFECTS, PHYSICAL EFFECTS, WEATHERING, CHEMICAL ANALYSIS, CRUDE OIL,
C-1698-76 DISPERSIONS, MODELS, OIL SLICKS, DRIFT, MOVEMENT,
C-1340-76 DISPOSAL , OIL SPILLS, ARCTIC, DETECTION, CLEANUP,
C-1461-76 DISTILLATION, WASTEWATER TREATMENT, OIL-WATER SEPARATION, SLUDGE, SOLVENTS,
C-1698-76 DRIFT, MODELS, OIL SLICKS, MOVEMENT, DISPERSIONS,
C-1701-76 DRIFT, MODELS, OIL SLICKS, SPREADING,
C-1657-76 DRILLING, OIL WELLS, POLLUTION PREVENTION, VENEZUELA,
C-1664-76 DRILLING, CONTAMINATION, TEXAS, *FRESHWATER AQUIFER,
C-1716-76 DRILLING, LEGISLATION, GROUNDWATER, CONTAMINATION, WATER QUALITY,
C-1731-76 DRILLING, REGULATIONS, BLOWOUT PREVENTION, CANADA,
C-1481-76 ECONOMIC EFFECTS, WASTEWATER TREATMENT, REFINERIES, OIL-WATER SEPARATION,
C-1527-76 ECONOMIC EFFECTS, MODELS, WASTEWATER TREATMENT, PETROCHEMICALS, *OLEFIN PRODUCTION,
C-1618-76 ECONOMIC EFFECTS, REGULATIONS, POLLUTION PREVENTION, OFFSHORE DEVELOPMENT, LEGISLATION,
C-1598-76 ECOSYSTEMS, ENVIRONMENTAL EFFECTS, BIOLOGICAL EFFECTS, CORAL REEFS, *MANGROVES, *SEA GRASS
C-1269-76 EIS, MONITORING, OIL SHALE DEVELOPMENT, ENVIRONMENTAL EFFECTS,
C-1424-76 EIS, REGULATIONS, TANKERS, DESIGN AND ENGINEERING, POLLUTION PREVENTION,

C-1448-76 EIS, DESIGN AND ENGINEERING, MANUALS, OIL SPILLS, WASTEWATER TREATMENT, BILGES,
C-1619-76 EIS, OIL-GAS LEASING, ATLANTIC COAST,
C-1623-76 EIS, OIL-GAS LEASING, ALASKA/GULF OF,
C-1624-76 EIS, OFFSHORE-DRILLING, OIL-GAS LEASING,
C-1625-76 EIS, OFFSHORE-DRILLING, ENVIRONMENTAL EFFECTS,
C-1631-76 EIS, SANTA BARBARA CHANNEL, OFFSHORE-DRILLING, OIL SPILLS,
C-1647-76 EIS, OCS, OFFSHORE-DEVELOPMENT, ENVIRONMENTAL EFFECTS, COASTS, ESTUARIES,
C-1652-76 EIS, OIL SHALE DEVELOPMENT, TAR SANDS, ENVIRONMENTAL EFFECTS, PRODUCTION, *WESTERN U.S.,
C-1653-76 EIS, OIL SHALE DEVELOPMENT, TAR SANDS, ENVIRONMENTAL EFFECTS, PRODUCTION, *WESTERN U.S.,
C-1659-76 EIS, OFFSHORE-DEVELOPMENT, OCS, NEW JERSEY, DELAWARE, ENVIRONMENTAL EFFECTS, OIL-GAS LEASING,
C-1660-76 EIS, OFFSHORE-DEVELOPMENT, OCS, SANTA BARBARA CHANNEL, ENVIRONMENTAL EFFECTS, OIL-GAS LEASING,
C-1718-76 EIS, LEGISLATION, INDUSTRIES, PETROLEUM INDUSTRY,
C-1371-76 EMULSIFICATION, *DETERGENTS, BILGES,
C-1391-76 EMULSIFICATION, CLEANUP, OIL SPILLS, TOXICITY, MARINE ORGANISMS,
C-1392-76 EMULSIFICATION, CLEANUP, OIL SPILLS, *DETERGENTS,
C-1523-76 EMULSIFICATION, TANKERS, WASTEWATER TREATMENT, BALLAST, BACTERIA,
C-1669-76 EMULSIFICATION, BIODEGRADATION, MICROORGANISMS, ARCTIC, ALASKA,
C-1670-76 EMULSIFICATION, BIODEGRADATION, HYDROCARBONS, YEASTS, ESTUARIES,
C-1676-76 EMULSIFICATION, BIODEGRADATION, REGULATIONS, CRANKCASE OIL, WATER QUALITY,
C-1389-76 EMULSIFIERS, BIOLOGICAL EFFECTS, MICROORGANISMS, *BENTHIC DIATOMS,
C-1580-76 EMULSIFIERS, TOXICITY, OIL SPILLS, MARINE ORGANISMS,
C-1325-76 EMULSIONS, CONTAINMENT, BOOMS, OIL SLICKS,
C-1374-76 EMULSIONS, WASTEWATER TREATMENT, OIL-WATER SEPARATION, COAGULATION,
C-1400-76 EMULSIONS, CLEANUP, CRUDE OIL, DISPERSIONS,
C-1460-76 EMULSIONS, WASTEWATER TREATMENT, OIL-WATER SEPARATION,
C-1470-76 EMULSIONS, WASTEWATER TREATMENT, OIL-WATER SEPARATION, FLOCCULATION,
C-1475-76 EMULSIONS, WASTEWATER TREATMENT, OIL-WATER SEPARATION, COALESCENCE,
C-1476-76 EMULSIONS, WASTE OIL DISPOSAL , REFINERIES, INCINERATION, SLUDGE,
C-1479-76 EMULSIONS, WASTEWATER TREATMENT, COALESCENCE,
C-1489-76 EMULSIONS, WASTE OIL TREATMENT, FILTRATION, *HYDROPHOBIC FIBERS,
C-1491-76 EMULSIONS, WASTEWATER TREATMENT, OIL-WATER SEPARATION, COALESCENCE,
C-1497-76 EMULSIONS, WASTEWATER TREATMENT, OIL-WATER SEPARATION, FLOCCULATION,

C-1500-76 EMULSIONS, WASTEWATER TREATMENT, OIL-WATER SEPARATION, FLOCCULATION,
C-1504-76 EMULSIONS, WASTEWATER TREATMENT, OIL-WATER SEPARATION, COALESCENCE,
C-1518-76 EMULSIONS, WASTEWATER TREATMENT, OIL-WATER SEPARATION, REFINERIES, FLCTATION,
C-1531-76 EMULSIONS, WASTEWATER TREATMENT, OIL-WATER SEPARATION, FLOCCULATION,
C-1532-76 EMULSIONS, WASTEWATER TREATMENT, FLOCCULATION, FILTRATION,
C-1694-76 ENTRAINMENT, MODELS, OIL SLICKS,
C-1251-76 ENVIRONMENTAL EFFECTS, OIL SPILLS,
C-1257-76 ENVIRONMENTAL EFFECTS, OCS, OFFSHORE-DEVELOPMENT, SAMPLING, MARINE ORGANISMS,
C-1267-76 ENVIRONMENTAL EFFECTS, MONITORING, ALASKA COAST, HYDROCARBONS, MICROORGANISMS,
C-1268-76 ENVIRONMENTAL EFFECTS, MONITORING, HYDROCARBONS,
C-1269-76 ENVIRONMENTAL EFFECTS, MONITORING, OIL SHALE DEVELOPMENT, EIS,
C-1303-76 ENVIRONMENTAL EFFECTS, STATISTICAL ANALYSIS, OIL SPILLS, PORTS, TANKERS, MODELS,
C-1434-76 ENVIRONMENTAL EFFECTS, TANKERS, PORTS, BAHAMAS, OIL SPILLS,
C-1510-76 ENVIRONMENTAL EFFECTS, WASTEWATER TREATMENT, REFINERIES, FISHERIES,
C-1595-76 ENVIRONMENTAL EFFECTS, OIL TRANSPORT, OIL SLICKS, OIL SPILLS, CALIFORNIA, NEW YORK,
C-1596-76 ENVIRONMENTAL EFFECTS, OIL SPILLS, LAKES, CANADA, ARCTIC, BIOLOGICAL EFFECTS,
C-1598-76 ENVIRONMENTAL EFFECTS, BIOLOGICAL EFFECTS, CORAL REEFS, *MANGROVES, *SEA GRASS ECOSYSTEMS,
C-1599-76 ENVIRONMENTAL EFFECTS, FRESHWATER, GROUNDWATER, OIL SPILLS,
C-1600-76 ENVIRONMENTAL EFFECTS, OIL SPILLS,
C-1601-76 ENVIRONMENTAL EFFECTS, OIL SPILLS, POLLUTION PREVENTION, OFFSHORE-PRODUCTION, TANKERS, LIABILITY,
C-1602-76 ENVIRONMENTAL EFFECTS, HYDROCARBONS, MANUALS,
C-1605-76 ENVIRONMENTAL EFFECTS, CRUDE OIL, SEDIMENTS, JAPAN,
C-1607-76 ENVIRONMENTAL EFFECTS, CONTAMINANTS, HYDROCARBONS, CRUDE OIL, ALASKA COAST,
C-1608-76 ENVIRONMENTAL EFFECTS, BIOLOGICAL EFFECTS, PETROCHEMICALS, WASTEWATER DISPOSAL ,
C-1609-76 ENVIRONMENTAL EFFECTS, FUEL OIL, CONTAMINATION, DECOMPOSITION, TOXICITY,
C-1615-76 ENVIRONMENTAL EFFECTS, MODELS, SOCIO-ECONOMIC EFFECTS, OFFSHORE-PRODUCTION, OIL SPILLS, EXPLORATION, ALASKA/GULF OF,
C-1621-76 ENVIRONMENTAL EFFECTS, OFFSHORE-EXPLORATION, OFFSHORE-PRODUCTION, OCS,
C-1622-76 ENVIRONMENTAL EFFECTS, OIL-GAS LEASING, BERING SEA, OFFSHORE-EXPLORATION,
C-1625-76 ENVIRONMENTAL EFFECTS, EIS, OFFSHORE-DRILLING, DRILLING, OIL-GAS LEASING,

C-1628-76	ENVIRONMENTAL EFFECTS, REFINERIES, FISHERIES, VIRGINIA,
C-1632-76	ENVIRONMENTAL EFFECTS, OIL SHALE DEVELOPMENT, USSR, PRODUCTION,
C-1635-76	ENVIRONMENTAL EFFECTS, PRODUCTION, TAR SANDS, CANADA,
C-1638-76	ENVIRONMENTAL EFFECTS, OFFSHORE-DEVELOPMENT, ECONOMIC EFFECTS, ATLANTIC COAST, ALASKA/GULF OF,
C-1640-76	ENVIRONMENTAL EFFECTS, OFFSHORE-DEVELOPMENT, FLORIDA COAST, REGULATIONS,
C-1645-76	ENVIRONMENTAL EFFECTS, OIL SHALE DEVELOPMENT, WASTEWATER DISPOSAL ,
C-1647-76	ENVIRONMENTAL EFFECTS, OCS, OFFSHORE-DEVELOPMENT, EIS, COASTS, ESTUARIES,
C-1648-76	ENVIRONMENTAL EFFECTS, NORTH SEA, OFFSHORE-DEVELOPMENT,
C-1650-76	ENVIRONMENTAL EFFECTS, PRODUCTION, PETROLEUM INDUSTRY, JAPAN,
C-1652-76	ENVIRONMENTAL EFFECTS, EIS, OIL SHALE DEVELOPMENT, TAR SANDS, PRODUCTION, *WESTERN U.S.,
C-1653-76	ENVIRONMENTAL EFFECTS, EIS, OIL SHALE DEVELOPMENT, TAR SANDS, PRODUCTION, *WESTERN U.S.,
C-1654-76	ENVIRONMENTAL EFFECTS, ALASKA/GULF OF, OIL-GAS LEASING, OFFSHORE-DEVELOPMENT, SOCIO-ECONOMIC EFFECTS,
C-1658-76	ENVIRONMENTAL EFFECTS, MONITORING, OIL SHALE DEVELOPMENT,
C-1659-76	ENVIRONMENTAL EFFECTS, EIS, OFFSHORE-DEVELOPMENT, OCS, NEW JERSEY, DELAWARE, OIL-GAS LEASING,
C-1661-76	ENVIRONMENTAL EFFECTS, OIL SHALE DEVELOPMENT, CONTAMINATION, GROUNDWATER, *COLORADO RIVER,
C-1662-76	ENVIRONMENTAL EFFECTS, WASTEWATER, OFFSHORE-PRODUCTION, MARINE ORGANISMS, TOXICITY,
C-1702-76	ENVIRONMENTAL EFFECTS, PORTS, OIL SPILLS, BAHAMAS, CANADA,
C-1703-76	ENVIRONMENTAL EFFECTS, HYDROCARBONS, ANALYTICAL TECHNIQUES, BIODEGRADATION, WEATHERING,
C-1704-76	ENVIRONMENTAL EFFECTS, OIL SPILLS, *BENZENE,
C-1708-76	ENVIRONMENTAL EFFECTS, MONITORING, BIOLOGICAL EFFECTS, HYDROCARBONS,
C-1709-76	ENVIRONMENTAL EFFECTS, BIOLOGICAL EFFECTS, OIL SPILLS, MARINE ORGANISMS, SHORELINES,
C-1634-76	ENVIRONMENTAL MANAGEMENT, COASTS, LEGISLATION, OFFSHORE-DEVELOPMENT,
C-1641-76	ENVIRONMENTAL MANAGEMENT, OFFSHORE-DEVELOPMENT, BIOLOGICAL EFFECTS, SOCIO-ECONOMIC EFFECTS,
C-1663-76	ENVIRONMENTAL MANAGEMENT, OIL SHALE DEVELOPMENT, CONSERVATION, *ENDANGERED SPECIES,
C-1423-76	ENVIRONMENTAL PROTECTION, NORTH SEA, WASTEWATER TREATMENT, MONITORING, *OIL TERMINAL,
C-1439-76	ENVIRONMENTAL PROTECTION, CRUDE OIL, STORAGE, *SALT DOMES,
C-1446-76	ENVIRONMENTAL PROTECTION, OIL TRANSPORT, CRUDE OIL, TANKERS,
C-1450-76	ENVIRONMENTAL PROTECTION, DESIGN AND ENGINEERING, OFFSHORE-DRILLING, TOXICITY, *DRILLING FLUID,

C-1495-76	ENVIRONMENTAL PROTECTION, WASTEWATER TREATMENT, BALLAST, OIL DISCHARGES, *OIL LOADING TERMINAL,
C-1597-76	ENVIRONMENTAL PROTECTION, PETROLEUM INDUSTRY, OIL SPILLS,
C-1630-76	ENVIRONMENTAL PROTECTION, OIL-GAS LEASING, ALASKA, BERING SEA,
C-1633-76	ENVIRONMENTAL PROTECTION, OIL-GAS LEASING, OCS, BERING SEA,
C-1639-76	ENVIRONMENTAL PROTECTION, OFFSHORE-EXPLORATION, OFFSHORE-PRODUCTION, OIL TRANSPORT, NORTH SEA,
C-1643-76	ENVIRONMENTAL PROTECTION, OFFSHORE-DRILLING, BIOLOGICAL EFFECTS, OIL SPILLS, BEAUFORT SEA, CANADA, DEVELOPMENT, OCS, REGULATIONS,
C-1655-76	ENVIRONMENTAL PROTECTION, OIL SHALE DEVELOPMENT, LAW ENFORCEMENT, REGULATIONS,
C-1717-76	ENVIRONMENTAL PROTECTION, U.S. GOVERNMENT, LEGISLATION, OFFSHORE-DEVELOPMENT, OCS, LIABILITY, OIL SPILLS,
C-1729-76	ENVIRONMENTAL PROTECTION, INTERNATIONAL CONVENTIONS, CONSERVATION,
C-1736-76	ENVIRONMENTAL PROTECTION, OIL SPILLS, CLEANUP, INTERNATIONAL CONVENTIONS, *SAFETY STANDARDS,
C-1275-76	ESTUARIES, REMOTE SENSING, OIL SLICKS, DELAWARE,
C-1647-76	ESTUARIES, OCS, OFFSHORE-DEVELOPMENT, EIS, ENVIRONMENTAL EFFECTS, COASTS,
C-1670-76	ESTUARIES, BIODEGRADATION, EMULSIFICATION, HYDROCARBONS, YEASTS,
C-1706-76	ESTUARIES, OIL SLICKS, MOVEMENT, COASTS, DELAWARE BAY,
C-1732-76	ESTUARIES, LEGISLATION, GREAT BRITAIN, OIL DISCHARGES, TANKERS, BILGES,
C-1250-76	EUROPE, OIL SPILLS, OIL TRANSPORT, PIPELINES, CLEANUP,
C-1734-76	EUROPE, GUIDELINES, POLLUTION PREVENTION, GROUNDWATER, OIL TRANSPORT, STORAGE,
C-1737-76	EUROPE, PETROLEUM INDUSTRY, REGULATIONS, PIPELINES, WASTEWATER TREATMENT,
C-1697-76	EVAPORATION, HYDROCARBONS, BIODEGRADATION, WEATHERING, *DISSOLUTION, *OCEAN WATERS,
C-1548-76	EXTRACTION, RECLAMATION, CRUDE OIL, *FLEXICOKING, *RESIDUAL OILS,
C-1484-76	FILTRATION, REFINERIES, WASTEWATER TREATMENT, OIL-WATER SEPARATION, FLOCCULATION,
C-1489-76	FILTRATION, WASTE OIL TREATMENT, EMULSIONS, *HYDROPHOBIC FIBERS,
C-1499-76	FILTRATION, WASTEWATER TREATMENT, FLOCCULATION, OIL-WATER SEPARATION,
C-1502-76	FILTRATION, WASTEWATER TREATMENT, OIL-WATER SEPARATION, FLOCCULATION,
C-1506-76	FILTRATION, REFINERIES, WASTEWATER TREATMENT, DESIGN AND ENGINEERING, ADSORPTION,
C-1512-76	FILTRATION, WASTEWATER TREATMENT, OIL-WATER SEPARATION, FLOCCULATION, DESIGN AND ENGINEERING,
C-1532-76	FILTRATION, WASTEWATER TREATMENT, EMULSIONS, FLOCCULATION,

C-1290-76 FISHES, CHEMICAL ANALYSIS, HYDROCARBONS,
C-1579-76 FISHES, BIOLOGICAL EFFECTS, CRUDE OIL, DISPERSANTS, *BALTIC HERRING,
C-1583-76 FISHES, BIOLOGICAL EFFECTS, HYDROCARBONS, FUEL OIL, *GIRELLA PUNCTATA, *EELS (ANGULLA ROSTRADA),
C-1587-76 FISHES, MONITORING, AROMATIC HYDROCARBONS , *COHO SALMON,
C-1656-76 FISHES, OFFSHORE-EXPLORATION, GEORGES BANK, ECONOMIC EFFECTS, OIL SPILLS,
C-1243-76 FISHERIES, OFFSHORE-EXPLORATION, PHYSICAL EFFECTS, BIOLOGICAL EFFECTS,
C-1510-76 FISHERIES, WASTEWATER TREATMENT, REFINERIES, ENVIRONMENTAL EFFECTS,
C-1614-76 FISHERIES, OFFSHORE-DEVELOPMENT, LOUISIANA, BIOLOGICAL EFFECTS, MARINE ORGANISMS,
C-1628-76 FISHERIES, REFINERIES, ENVIRONMENTAL EFFECTS, VIRGINIA,
C-1629-76 FISHERIES, OFFSHORE-DEVELOPMENT, NORTH SEA, ECONOMIC EFFECTS,
C-1640-76 FLORIDA COAST, OFFSHORE-DEVELOPMENT, ENVIRONMENTAL EFFECTS, REGULATIONS,
C-1470-76 FLOCCULATION, WASTEWATER TREATMENT, OIL-WATER SEPARATION, EMULSIONS,
C-1484-76 FLOCCULATION, REFINERIES, WASTEWATER TREATMENT, OIL-WATER SEPARATION, FILTRATION,
C-1490-76 FLOCCULATION, WASTEWATER TREATMENT, REFINERIES, COAGULATION,
C-1494-76 FLOCCULATION, WASTEWATER TREATMENT, OIL-WATER SEPARATION, ADSORPTION,
C-1497-76 FLOCCULATION, WASTEWATER TREATMENT, OIL-WATER SEPARATION, EMULSIONS,
C-1499-76 FLOCCULATION, WASTEWATER TREATMENT, OIL-WATER SEPARATION, FILTRATION,
C-1500-76 FLOCCULATION, WASTEWATER TREATMENT, OIL-WATER SEPARATION, EMULSIONS,
C-1502-76 FLOCCULATION, WASTEWATER TREATMENT, OIL-WATER SEPARATION, FILTRATION,
C-1503-76 FLOCCULATION, WASTEWATER TREATMENT, OIL-WATER SEPARATION, FLOTATION,
C-1512-76 FLOCCULATION, WASTEWATER TREATMENT, OIL-WATER SEPARATION, FILTRATION, DESIGN AND ENGINEERING,
C-1531-76 FLOCCULATION, WASTEWATER TREATMENT, EMULSIONS, OIL-WATER SEPARATION,
C-1532-76 FLOCCULATION, WASTEWATER TREATMENT, EMULSIONS, FILTRATION,
C-1535-76 FLOCCULATION, WASTEWATER TREATMENT, OIL-WATER SEPARATION, REFINERIES, FLOTATION,
C-1541-76 FLOCCULATION, WASTEWATER TREATMENT, OIL-WATER SEPARATION,
C-1699-76 FOOD WEB, HYDROCARBONS, CRUSTACEANS, *CALANUS HELGOLANDICUS CLAUS, *NAPHTHALENE, *DEPURATION,
C-1611-76 FRANCE, SEDIMENTS, CHEMICAL ANALYSIS, HYDROCARBONS, COASTS,

C-1591-76 FRESHWATER, BIOLOGICAL EFFECTS, CRUDE OIL, *NAPHTHALENE, ALGAE, *CHLAMYDOMONAS ANGULOSA,
C-1599-76 FRESHWATER, GROUNDWATER, OIL SPILLS, ENVIRONMENTAL EFFECTS,
C-1252-76 FUEL OIL, OIL SPILLS, CLEANUP, CONTINGENCY PLANNING, GREAT LAKES , *LAKE MICHIGAN, *HANNAH BARGE SPILL,
C-1311-76 FUEL OIL, SOURCE IDENTIFICATION, OIL SPILLS, CHEMICAL ANALYSIS, SPECTROMETRY, CHROMATOGRAPHY,
C-1551-76 FUEL OIL, WASTE OIL TREATMENT, RECLAMATION, CRANKCASE OIL, LUBRICATING OIL,
C-1568-76 FUEL OIL, BIOLOGICAL EFFECTS, MICROORGANISMS, PLANTS, SOIL, CRUDE OIL,
C-1571-76 FUEL OIL, BIOLOGICAL EFFECTS, MOLLUSKS,
C-1583-76 FUEL OIL, BIOLOGICAL EFFECTS, HYDROCARBONS, FISHES, *GIRELLA PUNCTATA, *EELS (ANGULLA ROSTRADA),
C-1584-76 FUEL OIL, CRUDE OIL, BIOLOGICAL EFFECTS, PHYTOPLANKTON, ALGAE,
C-1586-76 FUEL OIL, TOXICITY, CRUDE OIL, ANNELIDS, *NEANTHES ARENACEODENTATA,
C-1609-76 FUEL OIL, CONTAMINATION, ENVIRONMENTAL EFFECTS, DECOMPOSITION, TOXICITY,
C-1690-76 FUEL OIL, BIODEGRADATION, CRUDE OIL, BACTERIA,
C-1714-76 FUEL OIL, DECOMPOSITION, OIL SPILLS, WEATHERING, SOIL,
C-1573-76 FUNGI, HYDROCARBONS, *PENICILLIUM SP.,
C-1672-76 FUNGI, BIODEGRADATION, OXIDATION, HYDROCARBONS, CRUDE OIL, BACTERIA,
C-168[illegible]-76 FUNGI, BIODEGRADATION, MICROORGANISMS, BACTERIA, YEASTS, *ENUMERATION,
C-1689-76 FUNGI, OXIDATION, HYDROCARBONS, *CLADOSPORIUM RESINAE,
C-1733-76 GERMANY, WEST, GUIDELINES, POLLUTION PREVENTION, REGULATIONS, PERSONNEL TRAINING,
C-1387-76 GOVERNMENT AGENCIES, POLLUTION PREVENTION, OIL SPILLS, RECOVERY, CLEANUP, OIL DISCHARGES,
C-1416-76 GOVERNMENT AGENCIES, OIL SPILLS, CLEANUP, POLLUTION PREVENTION, INDUSTRY,
C-1562-76 GOVERNMENT AGENCIES, CONTINGENCY PLANNING, OIL SPILLS, POLLUTION PREVENTION,
C-1732-76 GREAT BRITAIN, LEGISLATION, ESTUARIES, OIL DISCHARGES, TANKERS, BILGES,
C-1252-76 GREAT LAKES , OIL SPILLS, FUEL OIL, CLEANUP, CONTINGENCY PLANNING, *LAKE MICHIGAN, *HANNAH BARGE SPILL,
C-1565-76 GREAT LAKES , CONTINGENCY PLANNING, OIL SPILLS, INLAND,
C-1680-76 GREAT LAKES , BIODEGRADATION, BACTERIA, MODELS,
C-1262-76 GROUNDWATER, MONITORING, CONTAMINATION, DETECTION, SAMPLING,
C-1463-76 GROUNDWATER, WASTEWATER TREATMENT, OIL SPILLS, WATER QUALITY,
C-1599-76 GROUNDWATER, FRESHWATER, OIL SPILLS, ENVIRONMENTAL EFFECTS,
C-1661-76 GROUNDWATER, ENVIRONMENTAL EFFECTS, OIL SHALE DEVELOPMENT, CONTAMINATION, *COLORADO RIVER,
C-1716-76 GROUNDWATER, LEGISLATION, CONTAMINATION, DRILLING, WATER QUALITY,

C-1734-76	GROUNDWATER, GUIDELINES, POLLUTION PREVENTION, OIL TRANSPORT, STORAGE, EUROPE,
C-1247-76	GUIDELINES, OIL SPILLS, INFORMATION SYSTEMS,
C-1447-76	GUIDELINES, DESIGN AND ENGINEERING, MANUALS, OIL SPILLS, WASTE OIL DISPOSAL , WASTEWATER TREATMENT,
C-1483-76	GUIDELINES, WASTEWATER, REFINERIES, ECONOMIC EFFECTS,
C-1525-76	GUIDELINES, PETROLEUM INDUSTRY, REFINERIES, WASTEWATER TREATMENT,
C-1564-76	GUIDELINES, CONTINGENCY PLANNING, OIL SPILLS, INLAND, CLEANUP,
C-1733-76	GUIDELINES, GERMANY, WEST, POLLUTION PREVENTION, REGULATIONS, PERSONNEL TRAINING,
C-1734-76	GUIDELINES, POLLUTION PREVENTION, GROUNDWATER, OIL TRANSPORT, STORAGE, EUROPE,
C-1735-76	GUIDELINES, POLLUTION PREVENTION, COASTS, INDONESIA, BIBLIOGRAPHIES,
C-1320-76	HARBORS, CONTAINMENT, OIL SPILLS, OIL TRANSFER, *BUBBLE BARRIER,
C-1339-76	HARBORS, CLEANUP, OIL SPILLS, JAPAN,
C-1413-76	HARBORS, CONTAINMENT, RECOVERY, OIL SPILLS, STREAMS,
C-1570-76	HEALTH HAZARDS, PETROCHEMICALS, TOXICITY, *LIQUID MEMBRANES,
C-1575-76	HEALTH HAZARDS, BIOLOGICAL EFFECTS, *ORGANIC POLLUTANTS,
C-1589-76	HEALTH HAZARDS, BIOLOGICAL EFFECTS, CRUDE OIL, HYDROCARBONS, AROMATIC HYDROCARBONS ,
C-1590-76	HEALTH HAZARDS, BIOLOGICAL EFFECTS, CRUDE OIL, HYDROCARBONS, AROMATIC HYDROCARBONS ,
C-1255-76	HYDROCARBONS, MONITORING, ANALYTICAL TECHNIQUES, WASTEWATER, REFINERIES,
C-1267-76	HYDROCARBONS, MONITORING, ENVIRONMENTAL EFFECTS, ALASKA COAST, MICROORGANISMS,
C-1268-76	HYDROCARBONS, MONITORING, ENVIRONMENTAL EFFECTS,
C-1272-76	HYDROCARBONS, MONITORING, CALIFORNIA COAST,
C-1282-76	HYDROCARBONS, SAMPLING, PACIFIC OCEAN, *TANKER ROUTES,
C-1283-76	HYDROCARBONS, ANALYTICAL TECHNIQUES, CHROMATOGRAPHY, SOURCE IDENTIFICATION,
C-1284-76	HYDROCARBONS, CHEMICAL ANALYSIS, CHROMATOGRAPHY, SOURCE IDENTIFICATION,
C-1289-76	HYDROCARBONS, CHEMICAL ANALYSIS, ALASKA/GULF OF, CHROMATOGRAPHY, SPECTROMETRY, *BASELINE STUDIES,
C-1290-76	HYDROCARBONS, CHEMICAL ANALYSIS, FISHES,
C-1291-76	HYDROCARBONS, CHEMICAL ANALYSIS, ANALYTICAL TECHNIQUES, CHROMATOGRAPHY, SEDIMENTS,
C-1292-76	HYDROCARBONS, ANALYTICAL TECHNIQUES, SOLVENTS, CHROMATOGRAPHY, SPECTROSCOPY,
C-1293-76	HYDROCARBONS, CHEMICAL ANALYSIS, WASTEWATER, CHROMATOGRAPHY,
C-1294-76	HYDROCARBONS, ANALYTICAL TECHNIQUES, CHROMATOGRAPHY, CARCINOGENS,
C-1296-76	HYDROCARBONS, ANALYTICAL TECHNIQUES, BIOLOGICAL EFFECTS, MARINE ORGANISMS, OFFSHORE-PRODUCTION,
C-1297-76	HYDROCARBONS, CHEMICAL ANALYSIS, SEDIMENTS, RIVERS, CHROMATOGRAPHY, SPECTROMETRY,

C-1298-76	HYDROCARBONS, ANALYTICAL TECHNIQUES, CHROMATOGRAPHY, SPECTROMETRY, RIVERS,
C-1299-76	HYDROCARBONS, ANALYTICAL TECHNIQUES, CHROMATOGRAPHY, DETECTION,
C-1302-76	HYDROCARBONS, CHEMICAL ANALYSIS, CHROMATOGRAPHY, SEDIMENTS, SEAWATER, SAMPLING,
C-1307-76	HYDROCARBONS, CHEMICAL ANALYSIS, MARINE ORGANISMS, CHROMATOGRAPHY, SPECTROMETRY,
C-1312-76	HYDROCARBONS, SOURCE IDENTIFICATION, MEXICO/GULF OF, SAMPLING, OFFSHORE-PRODUCTION, NATURAL SEEPAGE,
C-1485-76	HYDROCARBONS, WASTEWATER TREATMENT, RECOVERY, ADSORPTION,
C-1537-76	HYDROCARBONS, WASTEWATER TREATMENT, OIL-WATER SEPARATION, CRUDE OIL, HYDROCARBONS,
C-1573-76	HYDROCARBONS, FUNGI, *PENICILLIUM SP.,
C-1583-76	HYDROCARBONS, BIOLOGICAL EFFECTS, FUEL OIL, FISHES, *GIRELLA PUNCTATA, *EELS (ANGULLA ROSTRADA),
C-1589-76	HYDROCARBONS, BIOLOGICAL EFFECTS, HEALTH HAZARDS, CRUDE OIL, AROMATIC HYDROCARBONS ,
C-1590-76	HYDROCARBONS, BIOLOGICAL EFFECTS, HEALTH HAZARDS, CRUDE OIL, AROMATIC HYDROCARBONS ,
C-1592-76	HYDROCARBONS, TOXICITY, CRUDE OIL, CRUSTACEANS, *NAPHTHALENE, *GRASS SHRIMP,
C-1602-76	HYDROCARBONS, ENVIRONMENTAL EFFECTS, MANUALS,
C-1606-76	HYDROCARBONS, TOXICITY, AROMATIC HYDROCARBONS , BIOLOGICAL EFFECTS, BIBLIOGRAPHIES,
C-1607-76	HYDROCARBONS, ENVIRONMENTAL EFFECTS, CONTAMINANTS, CRUDE OIL, ALASKA COAST,
C-1611-76	HYDROCARBONS, SEDIMENTS, CHEMICAL ANALYSIS, COASTS, FRANCE,
C-1636-76	HYDROCARBONS, OFFSHORE-PRODUCTION, MEXICO/GULF OF, MONITORING,
C-1637-76	HYDROCARBONS, OFFSHORE-PRODUCTION, LOUISIANA, OIL SPILLS, BIOLOGICAL EFFECTS, ANALYTICAL TECHNIQUES,
C-1666-76	HYDROCARBONS, BIODEGRADATION, OIL SPILLS, BACTERIA,
C-1670-76	HYDROCARBONS, BIODEGRADATION, EMULSIFICATION, YEASTS, ESTUARIES,
C-1672-76	HYDROCARBONS, BIODEGRADATION, OXIDATION, CRUDE OIL, FUNGI, BACTERIA,
C-1673-76	HYDROCARBONS, BIODEGRADATION, MICROORGANISMS, BIBLIOGRAPHIES,
C-1677-76	HYDROCARBONS, BIODEGRADATION, OXIDATION, STREAMS, BACTERIA, *ARTHROBACTER SP., *MYCOBACTERIUM SP.,
C-1679-76	HYDROCARBONS, BIODEGRADATION, BACTERIA, NORTH CAROLINA, *THERMOMICROBIUM FOSTERI SP. NOV.,
C-1682-76	HYDROCARBONS, BIODEGRADATION, BACTERIA, CHEMICAL ANALYSIS, *HEXADECANE, JAPAN, *TOKYO BAY,
C-1685-76	HYDROCARBONS, BIODEGRADATION, BACTERIA, SEDIMENTS, ATLANTIC COAST,
C-1687-76	HYDROCARBONS, BIODEGRADATION, BACTERIA,
C-1688-76	HYDROCARBONS, BIODEGRADATION, BACTERIA, SEDIMENTS, CHESAPEAKE BAY, CHEMICAL ANALYSIS,
C-1689-76	HYDROCARBONS, OXIDATION, FUNGI, *CLADOSPORIUM RESINAE,

C-1692-76 HYDROCARBONS, BIODEGRADATION, MICROORGANISMS, POLLUTION PREVENTION, TOXICITY,

C-1697-76 HYDROCARBONS, EVAPORATION, BIODEGRADATION, WEATHERING, *DISSOLUTION, *OCEAN WATERS,

C-1699-76 HYDROCARBONS, FOOD WEB, CRUSTACEANS, *CALANUS HELGOLANDICUS CLAUS, *NAPHTHALENE, *DEPURATION,

C-1703-76 HYDROCARBONS, ANALYTICAL TECHNIQUES, BIODEGRADATION, WEATHERING, ENVIRONMENTAL EFFECTS,

C-1707-76 HYDROCARBONS, CHEMICAL ANALYSIS, SEDIMENTS,

C-1708-76 HYDROCARBONS, MONITORING, ENVIRONMENTAL EFFECTS, BIOLOGICAL EFFECTS,

C-1713-76 HYDROCARBONS, DECOMPOSITION, BIODEGRADATION,

C-1474-76 INCINERATION, WASTE OIL DISPOSAL , SHIPS, DESIGN AND ENGINEERING,

C-1476-76 INCINERATION, WASTE OIL DISPOSAL , REFINERIES, SLUDGE, EMULSIONS,

C-1478-76 INCINERATION, WASTEWATER DISPOSAL ,

C-1735-76 INDONESIA, GUIDELINES, POLLUTION PREVENTION, COASTS, BIBLIOGRAPHIES,

C-1363-76 INDUSTRIES, CLEANUP, POLLUTION PREVENTION, INTERNATIONAL AGREEMENTS,

C-1417-76 INDUSTRIES, CLEANUP, OIL SPILLS, CONTINGENCY PLANNING,

C-1718-76 INDUSTRIES, LEGISLATION, EIS, PETROLEUM INDUSTRY,

C-1242-76 INFORMATION SYSTEMS, OIL SPILLS,

C-1247-76 INFORMATION SYSTEMS, OIL SPILLS, GUIDELINES, EXPLORATION, OIL SPILLS,

C-1258-76 INTERNATIONAL AGREEMENTS, MONITORING, MEDITERRANEAN SEA, SAMPLING, CHEMICAL ANALYSIS,

C-1363-76 INTERNATIONAL AGREEMENTS, CLEANUP, POLLUTION PREVENTION, INDUSTRIES,

C-1722-76 INTERNATIONAL AGREEMENTS, MEDITERRANEAN SEA, OIL DISCHARGES, OIL SPILLS,

C-1724-76 INTERNATIONAL AGREEMENTS, LIABILITY, OIL SPILLS, NORTH SEA,

C-1253-76 INTERNATIONAL CONVENTIONS, MONITORING, DESIGN AND ENGINEERING, POLLUTION PREVENTION,

C-1444-76 INTERNATIONAL CONVENTIONS, REGULATIONS, POLLUTION PREVENTION, TANKERS, PETROLEUM INDUSTRY,

C-1723-76 INTERNATIONAL CONVENTIONS, OIL SPILLS, LIABILITY,

C-1725-76 INTERNATIONAL CONVENTIONS, OIL DISCHARGES, TANKERS, LOAD-ON-TOP, *DOUBLE BOTTOMS,

C-1726-76 INTERNATIONAL CONVENTIONS, OIL TRANSPORT, POLLUTION PREVENTION, TANKERS, OIL SPILLS,

C-1727-76 INTERNATIONAL CONVENTIONS, LAW ENFORCEMENT, TANKERS, POLLUTION PREVENTION, MONITORING, OIL DISCHARGES,

C-1728-76 INTERNATIONAL CONVENTIONS, POLLUTION PREVENTION, OIL DISCHARGES, *INTERNATIONAL LAW COMMISSION,

C-1729-76 INTERNATIONAL CONVENTIONS, ENVIRONMENTAL PROTECTION, CONSERVATION,

C-1730-76 INTERNATIONAL CONVENTIONS, POLLUTION PREVENTION, SHIPS, TANKERS, OIL DISCHARGES,

C-1736-76 INTERNATIONAL CONVENTIONS, OIL SPILLS, CLEANUP, ENVIRONMENTAL PROTECTION, *SAFETY STANDARDS,

C-1576-76 INVERTEBRATES, TOXICITY, CRUDE OIL, DISPERSANTS, FISH, RED SEA,
C-1588-76 INVERTEBRATES, BIOLOGICAL EFFECTS, CRUDE OIL, CONTAMINATION, RIVERS, *OIL-TREATED SUBSTRATES,
C-1339-76 JAPAN, CLEANUP, OIL SPILLS, HARBORS,
C-1605-76 JAPAN, CRUDE OIL, ENVIRONMENTAL EFFECTS, SEDIMENTS,
C-1650-76 JAPAN, ENVIRONMENTAL EFFECTS, PRODUCTION, PETROLEUM INDUSTRY,
C-1682-76 JAPAN, BIODEGRADATION, HYDROCARBONS, BACTERIA, CHEMICAL ANALYSIS, *HEXADECANE, *TOKYO BAY,
C-1593-76 KOREA, SOUTH, BIOLOGICAL EFFECTS, OIL SPILLS, WASTEWATER, REFINERIES, MOLLUSKS,
C-1596-76 LAKES, ENVIRONMENTAL EFFECTS, OIL SPILLS, CANADA, ARCTIC, BIOLOGICAL EFFECTS,
C-1691-76 LAKES, BIODEGRADATION, BACTERIA, *NUTRIENT LIMITATIONS, *TEMPERATURE,
C-1238-76 LAW ENFORCEMENT, OIL SPILLS, *INDIANA, *STREAM POLLUTION CONTROL BOARD,
C-1249-76 LAW ENFORCEMENT, REFINERIES, POLLUTION CONTROL RECORDS,
C-1655-76 LAW ENFORCEMENT, OIL SHALE DEVELOPMENT, REGULATIONS, ENVIRONMENTAL PROTECTION,
C-1727-76 LAW ENFORCEMENT, INTERNATIONAL CONVENTIONS, TANKERS, POLLUTION PREVENTION, MONITORING, OIL DISCHARGES,
C-1265-76 LEAKAGE, MONITORING, CONTAMINATION, OFFSHORE-DRILLING, DESIGN AND ENGINEERING,
C-1443-76 LEAKAGE, OFFSHORE-PIPELINES, DESIGN AND ENGINEERING,
C-1651-76 LEAKAGE, OFFSHORE-PRODUCTION, BLOWOUT PREVENTION, OIL WELLS,
C-1245-76 LEGISLATION, OIL SLICKS, COASTS, *NORTHWEST COAST,
C-1469-76 LEGISLATION, WASTE OIL DISPOSAL , RECYCLING,
C-1546-76 LEGISLATION, RECYCLING, U.S. GOVERNMENT, WASTE OIL TREATMENT, WASTE OIL DISPOSAL , RECLAMATION,
C-1547-76 LEGISLATION, WASTE OIL TREATMENT, REFINING, RECYCLING, REGULATIONS,
C-1617-76 LEGISLATION, *U.S. ENERGY PRODUCTION, SOCIAL EFFECTS,
C-1618-76 LEGISLATION, ECONOMIC EFFECTS, REGULATIONS, POLLUTION PREVENTION, OFFSHORE-DEVELOPMENT,
C-1634-76 LEGISLATION, COASTS, OFFSHORE-DEVELOPMENT, ENVIRONMENTAL MANAGEMENT,
C-1715-76 LEGISLATION, POLLUTION PREVENTION, *LITIGATION,
C-1716-76 LEGISLATION, GROUNDWATER, CONTAMINATION, DRILLING, WATER QUALITY,
C-1717-76 LEGISLATION, U.S. GOVERNMENT, OFFSHORE-DEVELOPMENT, OCS, ENVIRONMENTAL PROTECTION, LIABILITY, OIL SPILLS,
C-1718-76 LEGISLATION, EIS, INDUSTRIES, PETROLEUM INDUSTRY,
C-1719-76 LEGISLATION, OIL DISCHARGES,
C-1721-76 LEGISLATION, PETROLEUM INDUSTRY, REFINING, ECONOMIC EFFECTS,
C-1732-76 LEGISLATION, GREAT BRITAIN, ESTUARIES, OIL DISCHARGES, TANKERS, BILGES,
C-1601-76 LIABILITY, ENVIRONMENTAL EFFECTS, OIL SPILLS, POLLUTION PREVENTION, OFFSHORE-PRODUCTION, TANKERS, DEVELOPMENT, OCS, ENVIRONMENTAL PROTECTION, OIL SPILLS,

C-1723-76	LIABILITY, INTERNATIONAL CONVENTIONS, OIL SPILLS,
C-1724-76	LIABILITY, INTERNATIONAL AGREEMENTS, OIL SPILLS, NORTH SEA,
C-1435-76	LOAD-ON-TOP, TANKERS, POLLUTION PREVENTION, OIL DISCHARGES,
C-1725-76	LOAD-ON-TOP, INTERNATIONAL CONVENTIONS, OIL DISCHARGES, TANKERS, *DOUBLE BOTTOMS,
C-1260-76	LOUISIANA, MONITORING, MICROORGANISMS, OIL SPILLS,
C-1614-76	LOUISIANA, OFFSHORE-DEVELOPMENT, BIOLOGICAL EFFECTS, MARINE ORGANISMS, FISHERIES,
C-1637-76	LOUISIANA, HYDROCARBONS, OFFSHORE-PRODUCTION, OIL SPILLS, BIOLOGICAL EFFECTS, ANALYTICAL TECHNIQUES,
C-1545-76	LUBRICATING OIL, WASTE OIL TREATMENT, RECLAMATION, RECYCLING,
C-1551-76	LUBRICATING OIL, WASTE OIL TREATMENT, RECLAMATION, CRANKCASE OIL, FUEL OIL,
C-1553-76	LUBRICATING OIL, RECLAMATION, WASTE OIL TREATMENT,
C-1557-76	LUBRICATING OIL, RECLAMATION, WASTE OIL TREATMENT,
C-1407-76	MANUALS, CLEANUP, RECOVERY, DESIGN AND ENGINEERING,
C-1447-76	MANUALS, DESIGN AND ENGINEERING, GUIDELINES, OIL SPILLS, WASTE OIL DISPOSAL , WASTEWATER TREATMENT,
C-1448-76	MANUALS, DESIGN AND ENGINEERING, OIL SPILLS, WASTEWATER TREATMENT, BILGES, EIS,
C-1602-76	MANUALS, ENVIRONMENTAL EFFECTS, HYDROCARBONS, DEVELOPMENT, SAMPLING,
C-1264-76	MARINE ORGANISMS, MONITORING, BIOLOGICAL EFFECTS, OIL SPILLS, BEAUFORT SEA,
C-1296-76	MARINE ORGANISMS, ANALYTICAL TECHNIQUES, BIOLOGICAL EFFECTS, HYDROCARBONS, OFFSHORE-PRODUCTION,
C-1307-76	MARINE ORGANISMS, CHEMICAL ANALYSIS, HYDROCARBONS, CHROMATOGRAPHY, SPECTROMETRY,
C-1391-76	MARINE ORGANISMS, CLEANUP, EMULSIFICATION, OIL SPILLS, TOXICITY,
C-1569-76	MARINE ORGANISMS, BIOLOGICAL EFFECTS, CRUDE OIL,
C-1580-76	MARINE ORGANISMS, TOXICITY, OIL SPILLS, EMULSIFIERS, PRODUCTION, BIOLOGICAL EFFECTS, SANTA BARBARA CHANNEL,
C-1614-76	MARINE ORGANISMS, OFFSHORE-DEVELOPMENT, LOUISIANA, BIOLOGICAL EFFECTS, FISHERIES,
C-1662-76	MARINE ORGANISMS, ENVIRONMENTAL EFFECTS, WASTEWATER, OFFSHORE-PRODUCTION, TOXICITY,
C-1709-76	MARINE ORGANISMS, ENVIRONMENTAL EFFECTS, BIOLOGICAL EFFECTS, OIL SPILLS, SHORELINES,
C-1710-76	MARINE ORGANISMS, BIOLOGICAL EFFECTS, OIL SPILLS,
C-1258-76	MEDITERRANEAN SEA, MONITORING, SAMPLING, CHEMICAL ANALYSIS, INTERNATIONAL AGREEMENTS,
C-1722-76	MEDITERRANEAN SEA, INTERNATIONAL AGREEMENTS, OIL DISCHARGES, OIL SPILLS,
C-1248-76	METULA OIL SPILL, BIOLOGICAL EFFECTS, OIL SPILLS, BIRDS, SHORELINES,
C-1270-76	MEXICO/GULF OF, MONITORING, CHEMICAL ANALYSIS, NATURAL SEEPAGE, OFFSHORE-PRODUCTION, OIL DISCHARGES,
C-1312-76	MEXICO/GULF OF, SOURCE IDENTIFICATION, HYDROCARBONS, SAMPLING, OFFSHORE-PRODUCTION, NATURAL SEEPAGE,

C-1636-76 MEXICO/GULF OF, OFFSHORE-PRODUCTION, MONITORING, HYDROCARBONS,
C-1642-76 MEXICO/GULF OF, OFFSHORE-DRILLING, OFFSHORE-PRODUCTION, DESIGN AND ENGINEERING, POLLUTION PREVENTION,
C-1260-76 MICROORGANISMS, MONITORING, OIL SPILLS, LOUISIANA,
C-1267-76 MICROORGANISMS, MONITORING, ENVIRONMENTAL EFFECTS, ALASKA COAST, HYDROCARBONS,
C-1335-76 MICROORGANISMS, OIL SPILLS, CLEANUP, ABSORPTION, BIODEGRADATION,
C-1389-76 MICROORGANISMS, EMULSIFIERS, BIOLOGICAL EFFECTS, *BENTHIC DIATOMS,
C-1568-76 MICROORGANISMS, BIOLOGICAL EFFECTS, PLANTS, SOIL, CRUDE OIL, FUEL OIL,
C-1582-76 MICROORGANISMS, BIOLOGICAL EFFECTS, PETROCHEMICALS, SOIL, PLANTS,
C-1665-76 MICROORGANISMS, BIODEGRADATION, PETROCHEMICALS, *DEGRADATION INHIBITORS,
C-1669-76 MICROORGANISMS, BIODEGRADATION, EMULSIFICATION, ARCTIC, ALASKA,
C-1673-76 MICROORGANISMS, BIODEGRADATION, HYDROCARBONS, BIBLIOGRAPHIES,
C-1678-76 MICROORGANISMS, BIODEGRADATION, AROMATIC HYDROCARBONS , BACTERIA,
C-1681-76 MICROORGANISMS, BIODEGRADATION, AROMATIC HYDROCARBONS ,
C-1684-76 MICROORGANISMS, BIODEGRADATION, WASTEWATER TREATMENT, REFINERIES, TOXICITY,
C-1686-76 MICROORGANISMS, BIODEGRADATION, BACTERIA, YEASTS, FUNGI, *ENUMERATION,
C-1692-76 MICROORGANISMS, BIODEGRADATION, HYDROCARBONS, POLLUTION PREVENTION, TOXICITY,
C-1276-76 MODELS, REMOTE SENSING, OIL SLICKS, COASTS,
C-1280-76 MODELS, REMOTE SENSING, OIL SLICKS, WATER QUALITY,
C-1303-76 MODELS, STATISTICAL ANALYSIS, OIL SPILLS, PORTS, TANKERS, ENVIRONMENTAL EFFECTS,
C-1527-76 MODELS, WASTEWATER TREATMENT, ECONOMIC EFFECTS, PETROCHEMICALS, *OLEFIN PRODUCTION,
C-1615-76 MODELS, SOCIO-ECONOMIC EFFECTS, ENVIRONMENTAL EFFECTS, OFFSHORE-PRODUCTION, OIL SPILLS,
C-1680-76 MODELS, BIODEGRADATION, BACTERIA, GREAT LAKES ,
C-1694-76 MODELS, OIL SLICKS, ENTRAINMENT,
C-1698-76 MODELS, OIL SLICKS, DRIFT, MOVEMENT, DISPERSIONS,
C-1701-76 MODELS, OIL SLICKS, DRIFT, SPREADING,
C-1711-76 MODELS, OIL SLICKS, MOVEMENT, ATLANTIC COAST, DELAWARE, NEW JERSEY,
C-1712-76 MODELS, OIL SPILLS, NORTH SEA, CONTINGENCY PLANNING,
C-1261-76 MOLLUSKS, MONITORING, CARCINOGENS, CONTAMINATION, *BENZO(A)PYRENE,
C-1271-76 MOLLUSKS, MONITORING, BIOLOGICAL EFFECTS, OIL SLICKS, *MACOMA BALTHICA,
C-1571-76 MOLLUSKS, BIOLOGICAL EFFECTS, FUEL OIL,
C-1593-76 MOLLUSKS, BIOLOGICAL EFFECTS, OIL SPILLS, WASTEWATER, REFINERIES, KOREA, SOUTH,

C-1253-76	MONITORING, DESIGN AND ENGINEERING, POLLUTION PREVENTION, INTERNATIONAL CONVENTIONS,
C-1254-76	MONITORING, OIL DISCHARGES, SHIPS, BALLAST, DETECTION,
C-1255-76	MONITORING, ANALYTICAL TECHNIQUES, HYDROCARBONS, WASTEWATER, REFINERIES,
C-1256-76	MONITORING, OIL SPILLS, DETECTION, *OIL SENSOR, *OLEOPHILIC MEMBRANE,
C-1258-76	MONITORING, MEDITERRANEAN SEA, SAMPLING, CHEMICAL ANALYSIS, INTERNATIONAL AGREEMENTS,
C-1259-76	MONITORING, SOURCE IDENTIFICATION, TAR, SARGASSO SEA,
C-1260-76	MONITORING, MICROORGANISMS, OIL SPILLS, LOUISIANA,
C-1261-76	MONITORING, CARCINOGENS, CONTAMINATION, MOLLUSKS, *BENZO(A)PYRENE,
C-1262-76	MONITORING, GROUNDWATER, CONTAMINATION, DETECTION, SAMPLING,
C-1263-76	MONITORING, DETECTION, CONTAMINATION, WASTEWATER, *FLUORESCENCE, *IR AND UV LIGHT MEASUREMENT,
C-1264-76	MONITORING, MARINE ORGANISMS, BIOLOGICAL EFFECTS, OIL SPILLS, BEAUFORT SEA,
C-1265-76	MONITORING, CONTAMINATION, LEAKAGE, OFFSHORE-DRILLING, DESIGN AND ENGINEERING,
C-1266-76	MONITORING, DETECTION, OIL SPILLS, DESIGN AND ENGINEERING, *OIL SENSOR,
C-1267-76	MONITORING, ENVIRONMENTAL EFFECTS, ALASKA COAST, HYDROCARBONS, MICROORGANISMS,
C-1268-76	MONITORING, ENVIRONMENTAL EFFECTS, HYDROCARBONS,
C-1269-76	MONITORING, OIL SHALE DEVELOPMENT, EIS, ENVIRONMENTAL EFFECTS,
C-1270-76	MONITORING, CHEMICAL ANALYSIS, MEXICO/GULF OF, NATURAL SEEPAGE, OFFSHORE-PRODUCTION, OIL DISCHARGES,
C-1271-76	MONITORING, BIOLOGICAL EFFECTS, OIL SLICKS, MOLLUSKS, *MACOMA BALTHICA,
C-1272-76	MONITORING, HYDROCARBONS, CALIFORNIA COAST,
C-1274-76	MONITORING, REMOTE SENSING, DETECTION, OIL SPILLS,
C-1279-76	MONITORING, REMOTE SENSING, OIL DISCHARGES,
C-1423-76	MONITORING, ENVIRONMENTAL PROTECTION, NORTH SEA, WASTEWATER TREATMENT, *OIL TERMINAL,
C-1432-76	MONITORING, OIL TRANSFER, POLLUTION PREVENTION, OIL DISCHARGES, PERSONNEL TRAINING,
C-1533-76	MONITORING, REFINERIES, WASTEWATER TREATMENT, WATER QUALITY,
C-1587-76	MONITORING, AROMATIC HYDROCARBONS , FISHES, *COHO SALMON,
C-1636-76	MONITORING, OFFSHORE-PRODUCTION, MEXICO/GULF OF, HYDROCARBONS,
C-1658-76	MONITORING, OIL SHALE DEVELOPMENT, ENVIRONMENTAL EFFECTS,
C-1708-76	MONITORING, ENVIRONMENTAL EFFECTS, BIOLOGICAL EFFECTS, HYDROCARBONS,
C-1727-76	MONITORING, INTERNATIONAL CONVENTIONS, LAW ENFORCEMENT, TANKERS, POLLUTION PREVENTION, OIL DISCHARGES,
C-1278-76	MOVEMENT, REMOTE SENSING, ALASKA/GULF OF, OIL SPILLS, SPREADING,

C-1698-76 MOVEMENT, MODELS, OIL SLICKS, DRIFT, DISPERSIONS,
C-1700-76 MOVEMENT, OIL SPILLS, BIBLIOGRAPHIES, SPREADING, CLEANUP, DECOMPOSITION,
C-1706-76 MOVEMENT, OIL SLICKS, ESTUARIES, COASTS, DELAWARE BAY,
C-1711-76 MOVEMENT, MODELS, OIL SLICKS, ATLANTIC COAST, DELAWARE, NEW JERSEY,
C-1270-76 NATURAL SEEPAGE, MONITORING, CHEMICAL ANALYSIS, MEXICO/GULF OF, OFFSHORE-PRODUCTION, OIL DISCHARGES,
C-1285-76 NATURAL SEEPAGE, SAMPLING, CHEMICAL ANALYSIS, OIL WELLS, ALASKA/GULF OF,
C-1312-76 NATURAL SEEPAGE, SOURCE IDENTIFICATION, HYDROCARBONS, MEXICO/GULF OF, SAMPLING, OFFSHORE-PRODUCTION,
C-1404-76 NATURAL SEEPAGE, RECOVERY, DESIGN AND ENGINEERING,
C-1649-76 NATURAL SEEPAGE, OFFSHORE-DEVELOPMENT, SANTA BARBARA CHANNEL, OIL SPILLS,
C-1616-76 NEW HAMPSHIRE, REFINERIES, SOCIO-ECONOMIC EFFECTS,
C-1659-76 NEW JERSEY, EIS, OFFSHORE-DEVELOPMENT, OCS, DELAWARE, ENVIRONMENTAL EFFECTS, OIL-GAS LEASING,
C-1711-76 NEW JERSEY, MODELS, OIL SLICKS, MOVEMENT, ATLANTIC COAST, DELAWARE,
C-1246-76 NEW YORK, OIL SPILLS, CLEANUP,
C-1595-76 NEW YORK, OIL TRANSPORT, OIL SLICKS, ENVIRONMENTAL EFFECTS, OIL SPILLS, CALIFORNIA,
C-1679-76 NORTH CAROLINA, BIODEGRADATION, HYDROCARBONS, BACTERIA, *THERMOMICROBIUM FOSTERI SP. NOV.,
C-1423-76 NORTH SEA, ENVIRONMENTAL PROTECTION, WASTEWATER TREATMENT, MONITORING, *OIL TERMINAL,
C-1629-76 NORTH SEA, OFFSHORE-DEVELOPMENT, FISHERIES, ECONOMIC EFFECTS, EXPLORATION, OFFSHORE PRODUCTION, OIL TRANSPORT,
C-1648-76 NORTH SEA, OFFSHORE-DEVELOPMENT, ENVIRONMENTAL EFFECTS,
C-1712-76 NORTH SEA, MODELS, OIL SPILLS, CONTINGENCY PLANNING,
C-1724-76 NORTH SEA, INTERNATIONAL AGREEMENTS, LIABILITY, OIL SPILLS,
C-1244-76 OCS, OIL-GAS LEASING, ALASKA/GULF OF,
C-1257-76 OCS, ENVIRONMENTAL EFFECTS, OFFSHORE-DEVELOPMENT, SAMPLING, MARINE ORGANISMS,
C-1277-76 OCS, REMOTE SENSING, OFFSHORE-DEVELOPMENT, *ONSHORE IMPACTS,
C-1333-76 OCS, CLEANUP, POLLUTION PREVENTION, ARCTIC, BIBLIOGRAPHIES,
C-1427-76 OCS, OIL TRANSPORT, STORAGE, ALASKA/GULF OF, OIL SPILLS,
C-1428-76 OCS, OIL TRANSPORT, CALIFORNIA, OIL SPILLS,
C-1621-76 OCS, OFFSHORE-EXPLORATION, OFFSHORE-PRODUCTION, ENVIRONMENTAL EFFECTS,
C-1627-76 OCS, OIL-GAS LEASING, ALASKA,
C-1633-76 OCS, OIL-GAS LEASING, BERING SEA, ENVIRONMENTAL PROTECTION,
C-1646-76 OCS, OFFSHORE-DRILLING, OFFSHORE-DEVELOPMENT, REGULATIONS, ENVIRONMENTAL PROTECTION,
C-1647-76 OCS, OFFSHORE-DEVELOPMENT, EIS, ENVIRONMENTAL EFFECTS, COASTS, ESTUARIES,

C-1659-76	OCS, EIS, OFFSHORE-DEVELOPMENT, NEW JERSEY, DELAWARE, ENVIRONMENTAL EFFECTS, OIL-GAS LEASING,
C-1660-76	OCS, EIS, OFFSHORE-DEVELOPMENT, SANTA BARBARA CHANNEL, ENVIRONMENTAL EFFECTS, OIL-GAS LEASING, DEVELOPMENT, ENVIRONMENTAL PROTECTION, LIABILITY,
C-1240-76	OFFSHORE-DEVELOPMENT, OIL SPILLS, ALASKA/GULF OF, PETROLEUM INDUSTRY,
C-1257-76	OFFSHORE-DEVELOPMENT, OCS, ENVIRONMENTAL EFFECTS, SAMPLING, MARINE ORGANISMS,
C-1277-76	OFFSHORE-DEVELOPMENT, REMOTE SENSING, OCS, *ONSHORE IMPACTS,
C-1425-76	OFFSHORE-DEVELOPMENT, OIL TRANSFER, WASHINGTON, OIL SPILLS,
C-1614-76	OFFSHORE-DEVELOPMENT, LOUISIANA, BIOLOGICAL EFFECTS, MARINE ORGANISMS, FISHERIES,
C-1618-76	OFFSHORE-DEVELOPMENT, ECONOMIC EFFECTS, REGULATIONS, POLLUTION PREVENTION, LEGISLATION,
C-1629-76	OFFSHORE-DEVELOPMENT, NORTH SEA, FISHERIES, ECONOMIC EFFECTS,
C-1634-76	OFFSHORE-DEVELOPMENT, COASTS, LEGISLATION, ENVIRONMENTAL MANAGEMENT,
C-1638-76	OFFSHORE-DEVELOPMENT, ENVIRONMENTAL EFFECTS, ECONOMIC EFFECTS, ATLANTIC COAST, ALASKA/GULF OF,
C-1640-76	OFFSHORE-DEVELOPMENT, FLORIDA COAST, ENVIRONMENTAL EFFECTS, REGULATIONS, ECONOMIC EFFECTS, ENVIRONMENTAL MANAGEMENT,
C-1646-76	OFFSHORE-DEVELOPMENT, OFFSHORE-DRILLING, OCS, REGULATIONS, ENVIRONMENTAL PROTECTION,
C-1647-76	OFFSHORE-DEVELOPMENT, OCS, EIS, ENVIRONMENTAL EFFECTS, COASTS, ESTUARIES,
C-1648-76	OFFSHORE-DEVELOPMENT, NORTH SEA, ENVIRONMENTAL EFFECTS,
C-1649-76	OFFSHORE-DEVELOPMENT, SANTA BARBARA CHANNEL, NATURAL SEEPAGE, OIL SPILLS,
C-1654-76	OFFSHORE-DEVELOPMENT, ALASKA/GULF OF, OIL-GAS LEASING, ENVIRONMENTAL EFFECTS, SOCIO-ECONOMIC EFFECTS,
C-1659-76	OFFSHORE-DEVELOPMENT, EIS, OCS, NEW JERSEY, DELAWARE, ENVIRONMENTAL EFFECTS, OIL-GAS LEASING,
C-1660-76	OFFSHORE-DEVELOPMENT, EIS, OCS, SANTA BARBARA CHANNEL, ENVIRONMENTAL EFFECTS, OIL-GAS LEASING,
C-1717-76	OFFSHORE-DEVELOPMENT, U.S. GOVERNMENT, LEGISLATION, OCS, ENVIRONMENTAL PROTECTION, LIABILITY, OIL SPILLS,
C-1265-76	OFFSHORE-DRILLING, MONITORING, CONTAMINATION, LEAKAGE, DESIGN AND ENGINEERING,
C-1450-76	OFFSHORE-DRILLING, DESIGN AND ENGINEERING, TOXICITY, *DRILLING FLUID, ENVIRONMENTAL PROTECTION,
C-1454-76	OFFSHORE-DRILLING, DESIGN AND ENGINEERING, BLOWOUT PREVENTION, OIL WELLS,
C-1513-76	OFFSHORE-DRILLING, *WELL CUTTINGS DISPOSAL , OIL-WATER SEPARATION, DESIGN AND ENGINEERING,
C-1612-76	OFFSHORE-DRILLING, OFFSHORE-PRODUCTION, BIOLOGICAL EFFECTS, MARINE ORGANISMS, SANTA BARBARA CHANNEL,
C-1624-76	OFFSHORE-DRILLING, EIS, OIL-GAS LEASING,
C-1625-76	OFFSHORE-DRILLING, EIS, ENVIRONMENTAL EFFECTS,

C-1626-76	OFFSHORE-DRILLING, ALASKA/GULF OF, OIL-GAS LEASING, ENVIRONMENTAL EFFECTS,
C-1631-76	OFFSHORE-DRILLING, SANTA BARBARA CHANNEL, EIS, OIL SPILLS,
C-1642-76	OFFSHORE-DRILLING, OFFSHORE-PRODUCTION, MEXICO/GULF OF, DESIGN AND ENGINEERING, POLLUTION PREVENTION,
C-1643-76	OFFSHORE-DRILLING, ENVIRONMENTAL PROTECTION, BIOLOGICAL EFFECTS, OIL SPILLS, BEAUFORT SEA, CANADA,
C-1646-76	OFFSHORE-DRILLING, OFFSHORE-DEVELOPMENT, OCS, REGULATIONS, ENVIRONMENTAL PROTECTION,
C-1243-76	OFFSHORE-EXPLORATION, PHYSICAL EFFECTS, BIOLOGICAL EFFECTS, FISHERIES,
C-1457-76	OFFSHORE-EXPLORATION, DESIGN AND ENGINEERING, INFORMATION SYSTEMS, OIL SPILLS,
C-1620-76	OFFSHORE-EXPLORATION, OIL-GAS LEASING, ENVIRONMENTAL EFFECTS, ALASKA/GULF OF,
C-1621-76	OFFSHORE-EXPLORATION, OFFSHORE-PRODUCTION, ENVIRONMENTAL EFFECTS, OCS,
C-1622-76	OFFSHORE-EXPLORATION, OIL-GAS LEASING, BERING SEA, ENVIRONMENTAL EFFECTS,
C-1639-76	OFFSHORE-EXPLORATION, ENVIRONMENTAL PROTECTION, OFFSHORE-PRODUCTION, OIL TRANSPORT, NORTH SEA,
C-1644-76	OFFSHORE-EXPLORATION, POLLUTION PREVENTION, CANADA, *LABRADOR,
C-1656-76	OFFSHORE-EXPLORATION, GEORGES BANK, ECONOMIC EFFECTS, FISHES, OIL SPILLS,
C-1443-76	OFFSHORE-PIPELINES, LEAKAGE, DESIGN AND ENGINEERING,
C-1270-76	OFFSHORE-PRODUCTION, MONITORING, CHEMICAL ANALYSIS, MEXICO/GULF OF, NATURAL SEEPAGE, OIL DISCHARGES,
C-1296-76	OFFSHORE-PRODUCTION, ANALYTICAL TECHNIQUES, BIOLOGICAL EFFECTS, HYDROCARBONS, MARINE ORGANISMS,
C-1312-76	OFFSHORE-PRODUCTION, SOURCE IDENTIFICATION, HYDROCARBONS, MEXICO/GULF OF, SAMPLING, NATURAL SEEPAGE,
C-1464-76	OFFSHORE-PRODUCTION, WASTEWATER TREATMENT, OIL-WATER SEPARATION, RECOVERY,
C-1601-76	OFFSHORE-PRODUCTION, ENVIRONMENTAL EFFECTS, OIL SPILLS, POLLUTION PREVENTION, TANKERS, LIABILITY,
C-1612-76	OFFSHORE-PRODUCTION, OFFSHORE-DRILLING, BIOLOGICAL EFFECTS, MARINE ORGANISMS, SANTA BARBARA CHANNEL,
C-1615-76	OFFSHORE-PRODUCTION, MODELS, SOCIO-ECONOMIC EFFECTS, ENVIRONMENTAL EFFECTS, OIL SPILLS,
C-1621-76	OFFSHORE-PRODUCTION, OFFSHORE-EXPLORATION, ENVIRONMENTAL EFFECTS, OCS,
C-1636-76	OFFSHORE-PRODUCTION, MEXICO/GULF OF, MONITORING, HYDROCARBONS,
C-1637-76	OFFSHORE-PRODUCTION, HYDROCARBONS, LOUISIANA, OIL SPILLS, BIOLOGICAL EFFECTS, ANALYTICAL TECHNIQUES,
C-1639-76	OFFSHORE-PRODUCTION, ENVIRONMENTAL PROTECTION, OFFSHORE-EXPLORATION, OFFSHORE-PRODUCTION, OIL TRANSPORT, NORTH SEA ,
C-1642-76	OFFSHORE-PRODUCTION, OFFSHORE-DRILLING, MEXICO/GULF OF, DESIGN AND ENGINEERING, POLLUTION PREVENTION,
C-1651-76	OFFSHORE-PRODUCTION, LEAKAGE, BLOWOUT PREVENTION, OIL WELLS,

C-1662-76 OFFSHORE-PRODUCTION, ENVIRONMENTAL EFFECTS, WASTEWATER, MARINE ORGANISMS, TOXICITY,
C-1237-76 OIL DISCHARGES, FUELS,
C-1254-76 OIL DISCHARGES, MONITORING, SHIPS, BALLAST, DETECTION,
C-1270-76 OIL DISCHARGES, MONITORING, CHEMICAL ANALYSIS, MEXICO/GULF OF, NATURAL SEEPAGE, OFFSHORE-PRODUCTION,
C-1279-76 OIL DISCHARGES, REMOTE SENSING, MONITORING,
C-1387-76 OIL DISCHARGES, POLLUTION PREVENTION, GOVERNMENT AGENCIES, OIL SPILLS, RECOVERY, CLEANUP,
C-1432-76 OIL DISCHARGES, OIL TRANSFER, POLLUTION PREVENTION, PERSONNEL TRAINING, MONITORING,
TOP,
C-1495-76 OIL DISCHARGES, WASTEWATER TREATMENT, BALLAST, ENVIRONMENTAL PROTECTION, *OIL LOADING TERMINAL,
C-1567-76 OIL DISCHARGES, CONTINGENCY PLANNING, PERSONNEL TRAINING, OIL TRANSPORT,
C-1719-76 OIL DISCHARGES, LEGISLATION,
C-1722-76 OIL DISCHARGES, INTERNATIONAL AGREEMENTS, MEDITERRANEAN SEA, OIL SPILLS,
C-1725-76 OIL DISCHARGES, INTERNATIONAL CONVENTIONS, TANKERS, LOAD-ON-TOP, *DOUBLE BOTTOMS,
C-1726-76 INTERNATIONAL CONVENTIONS, OIL TRANSPORT, POLLUTION PREVENTION, TANKERS, OIL SPILLS,
C-1727-76 OIL DISCHARGES, INTERNATIONAL CONVENTIONS, LAW ENFORCEMENT, TANKERS, POLLUTION PREVENTION, MONITORING,
C-1728-76 OIL DISCHARGES, INTERNATIONAL CONVENTIONS, POLLUTION PREVENTION, *INTERNATIONAL LAW COMMISSION,
C-1732-76 OIL DISCHARGES, LEGISLATION, GREAT BRITAIN, ESTUARIES, TANKERS, BILGES,
C-1244-76 OIL-GAS LEASING, ALASKA/GULF OF, OCS,
C-1619-76 OIL-GAS LEASING, ATLANTIC COAST, EIS, EXPLORATION, ALASKA/GULF OF,
C-1622-76 OIL-GAS LEASING, BERING SEA, ENVIRONMENTAL EFFECTS, OFFSHORE-EXPLORATION,
C-1623-76 OIL-GAS LEASING, ALASKA/GULF OF, EIS,
C-1624-76 OIL-GAS LEASING, EIS, OFFSHORE-DRILLING,
C-1626-76 OIL-GAS LEASING, ALASKA/GULF OF, OFFSHORE-DRILLING, ENVIRONMENTAL EFFECTS,
C-1627-76 OIL-GAS LEASING, ALASKA, OCS,
C-1630-76 OIL-GAS LEASING, ALASKA, BERING SEA, ENVIRONMENTAL PROTECTION,
C-1633-76 OIL-GAS LEASING, OCS, BERING SEA, ENVIRONMENTAL PROTECTION,
C-1654-76 OIL-GAS LEASING, ALASKA/GULF OF, OFFSHORE-DEVELOPMENT, ENVIRONMENTAL EFFECTS, SOCIO-ECONOMIC EFFECTS,
C-1659-76 OIL-GAS LEASING, EIS, OFFSHORE-DEVELOPMENT, OCS, NEW JERSEY, DELAWARE, ENVIRONMENTAL EFFECTS,
C-1660-76 OIL-GAS LEASING, EIS, OFFSHORE-DEVELOPMENT, OCS, SANTA BARBARA CHANNEL, ENVIRONMENTAL EFFECTS,
C-1632-76 OIL SHALE DEVELOPMENT, USSR, ENVIRONMENTAL EFFECTS, PRODUCTION,
C-1645-76 OIL SHALE DEVELOPMENT, ENVIRONMENTAL EFFECTS, WASTEWATER DISPOSAL,

C-1652-76	OIL SHALE DEVELOPMENT, EIS, TAR SANDS, ENVIRONMENTAL EFFECTS, PRODUCTION, *WESTERN U.S.,
C-1653-76	OIL SHALE DEVELOPMENT, EIS, TAR SANDS, ENVIRONMENTAL EFFECTS, PRODUCTION, *WESTERN U.S.,
C-1655-76	OIL SHALE DEVELOPMENT, LAW ENFORCEMENT, REGULATIONS, ENVIRONMENTAL PROTECTION,
C-1658-76	OIL SHALE DEVELOPMENT, MONITORING, ENVIRONMENTAL EFFECTS,
C-1661-76	OIL SHALE DEVELOPMENT, ENVIRONMENTAL EFFECTS, GROUNDWATER, *COLORADO RIVER,
C-1663-76	OIL SHALE DEVELOPMENT, ENVIRONMENTAL MANAGEMENT, CONSERVATION, *ENDANGERED SPECIES,
C-1245-76	OIL SLICKS, COASTS, LEGISLATION, *NORTHWEST COAST,
C-1271-76	OIL SLICKS, MONITORING, BIOLOGICAL EFFECTS, MOLLUSKS, *MACOMA BALTHICA,
C-1273-76	OIL SLICKS, REMOTE SENSING, DESIGN AND ENGINEERING,
C-1275-76	OIL SLICKS, REMOTE SENSING, ESTUARIES, DELAWARE,
C-1276-76	OIL SLICKS, REMOTE SENSING, MODELS, COASTS,
C-1280-76	OIL SLICKS, REMOTE SENSING, MODELS, WATER QUALITY,
C-1310-76	OIL SLICKS, SOURCE IDENTIFICATION, OIL SPILLS, ANALYTICAL TECHNIQUES, WEATHERING, SAMPLING,
C-1319-76	OIL SLICKS, CONTAINMENT, BOOMS, DESIGN AND ENGINEERING,
C-1324-76	OIL SLICKS, CONTAINMENT, DESIGN AND ENGINEERING, *OIL SCREEN,
C-1325-76	OIL SLICKS, CONTAINMENT, BOOMS, EMULSIONS,
C-1326-76	OIL SLICKS, CONTAINMENT, CRUDE OIL, *OIL HERDERS,
C-1329-76	OIL SLICKS, CONTAINMENT, DESIGN AND ENGINEERING,
C-1346-76	OIL SLICKS, RECOVERY, ABSORPTION,
C-1347-76	OIL SLICKS, SKIMMERS, RECOVERY, REFINERIES,
C-1355-76	OIL SLICKS, CLEANUP, CONTAINMENT, DESIGN AND ENGINEERING, *ENVIRONMENTAL TEST TANK,
C-1358-76	OIL SLICKS, RECOVERY, SKIMMERS,
C-1361-76	OIL SLICKS, CONTAINMENT, RECOVERY, DESIGN AND ENGINEERING,
C-1366-76	OIL SLICKS, RECOVERY, OIL SPILLS, DESIGN AND ENGINEERING,
C-1373-76	OIL SLICKS, CLEANUP, DISPERSANTS, OIL SPILLS, *DETERGENTS,
C-1376-76	OIL SLICKS, SKIMMERS, RECOVERY, DESIGN AND ENGINEERING,
C-1377-76	OIL SLICKS, RECOVERY, SKIMMERS, DESIGN AND ENGINEERING,
C-1378-76	OIL SLICKS, RECOVERY, DESIGN AND ENGINEERING, *OIL COLLECTOR,
C-1386-76	OIL SLICKS, RECOVERY, DESIGN AND ENGINEERING, *OLEOPHILIC DISCS,
C-1394-76	OIL SLICKS, RECOVERY, SKIMMERS, DESIGN AND ENGINEERING,
C-1396-76	OIL SLICKS, RECOVERY, BOOMS, DESIGN AND ENGINEERING,
C-1402-76	OIL SLICKS, CLEANUP, OIL SPILLS, ADSORPTION,
C-1411-76	OIL SLICKS, CLEANUP, RECOVERY,
C-1418-76	OIL SLICKS, SKIMMERS, OIL-WATER SEPARATION, DESIGN AND ENGINEERING,
C-1595-76	OIL SLICKS, OIL TRANSPORT, ENVIRONMENTAL EFFECTS, OIL SPILLS, CALIFORNIA, NEW YORK,

C-1674-76	OIL SLICKS, BIODEGRADATION, SEAWATER,
C-1693-76	OIL SLICKS, SPREADING, COASTS,
C-1694-76	OIL SLICKS, MODELS, ENTRAINMENT,
C-1698-76	OIL SLICKS, MODELS, DRIFT, MOVEMENT, DISPERSIONS,
C-1701-76	OIL SLICKS, MODELS, DRIFT, SPREADING,
C-1706-76	OIL SLICKS, MOVEMENT, ESTUARIES, COASTS, DELAWARE BAY,
C-1711-76	OIL SLICKS, MODELS, MOVEMENT, ATLANTIC COAST, DELAWARE, NEW JERSEY,
C-1238-76	OIL SPILLS, LAW ENFORCEMENT, *INDIANA, *STREAM POLLUTION CONTROL BOARD,
C-1239-76	OIL SPILLS, BIOLOGICAL EFFECTS, BIRDS, CHESAPEAKE BAY,
C-1240-76	OIL SPILLS, ALASKA/GULF OF, OFFSHORE-DEVELOPMENT, PETROLEUM INDUSTRY,
C-1242-76	OIL SPILLS, INFORMATION SYSTEMS,
C-1246-76	OIL SPILLS, CLEANUP, NEW YORK,
C-1247-76	OIL SPILLS, INFORMATION SYSTEMS, GUIDELINES,
C-1248-76	OIL SPILLS, BIOLOGICAL EFFECTS, METULA OIL SPILL, BIRDS, SHORELINES,
C-1250-76	OIL SPILLS, OIL TRANSPORT, PIPELINES, EUROPE, CLEANUP,
C-1251-76	OIL SPILLS, ENVIRONMENTAL EFFECTS,
C-1252-76	OIL SPILLS, FUEL OIL, CLEANUP, CONTINGENCY PLANNING, GREAT LAKES , *LAKE MICHIGAN, *HANNAH BARGE SPILL,
C-1256-76	OIL SPILLS, MONITORING, DETECTION, *OIL SENSOR, *OLEOPHILIC MEMBRANE,
C-1260-76	OIL SPILLS, MONITORING, *MICROORGANISMS, LOUISIANA,
C-1264-76	OIL SPILLS, MONITORING, MARINE ORGANISMS, BIOLOGICAL EFFECTS, BEAUFORT SEA,
C-1266-76	OIL SPILLS, MONITORING, DETECTION, DESIGN AND ENGINEERING, *OIL SENSOR,
C-1274-76	OIL SPILLS, REMOTE SENSING, DETECTION, MONITORING,
C-1278-76	OIL SPILLS, REMOTE SENSING, ALASKA/GULF OF, MOVEMENT, SPREADING,
C-1300-76	OIL SPILLS, CHEMICAL ANALYSIS, SOURCE IDENTIFICATION, *INFRARED SPECTROPHOTOMETRY, *DISCRIMINANT ANALYSIS,
C-1303-76	OIL SPILLS, STATISTICAL ANALYSIS, PORTS, TANKERS, ENVIRONMENTAL EFFECTS, MODELS,
C-1306-76	OIL SPILLS, CHEMICAL ANALYSIS, SAMPLING, SEDIMENTS, CHESAPEAKE BAY,
C-1308-76	OIL SPILLS, SOURCE IDENTIFICATION, ANALYTICAL TECHNIQUES, CHROMATOGRAPHY, SPECTROSCOPY, SAMPLING,
C-1309-76	OIL SPILLS, SOURCE IDENTIFICATION, SPECTROMETRY,
C-1310-76	OIL SPILLS, SOURCE IDENTIFICATION, OIL SLICKS, ANALYTICAL TECHNIQUES, WEATHERING, SAMPLING,
C-1311-76	OIL SPILLS, SOURCE IDENTIFICATION, FUEL OIL, CHEMICAL ANALYSIS, SPECTROMETRY, CHROMATOGRAPHY,
C-1313-76	OIL SPILLS, SOURCE IDENITFICATION, CHEMICAL ANALYSIS, SPECTROSCOPY,
C-1315-76	OIL SPILLS, SOURCE IDENTIFICATION, CHEMICAL ANALYSIS, *FLUORIMETRY,
C-1318-76	OIL SPILLS, CONTAINMENT, BOOMS, WASTEWATER,
C-1320-76	OIL SPILLS, CONTAINMENT, HARBORS, OIL TRANSFER, *BUBBLE BARRIER,

C-1321-76	OIL SPILLS, CONTAINMENT, INLAND, DESIGN AND ENGINEERING, *TRANSFORMER COOLANT OIL,
C-1322-76	OIL SPILLS, CONTAINMENT,
C-1327-76	OIL SPILLS, CONTAINMENT, BOOMS, DESIGN AND ENGINEERING,
C-1330-76	OIL SPILLS, CONTAINMENT, BOOMS, DESIGN AND ENGINEERING,
C-1331-76	OIL SPILLS, CLEANUP, *AGGLOMERATION,
C-1332-76	OIL SPILLS, CLEANUP, INLAND, CONTINGENCY PLANNING,
C-1334-76	OIL SPILLS, RECOVERY, ABSORPTION,
C-1335-76	OIL SPILLS, CLEANUP, ABSORPTION, BIODEGRADATION, MICROORGANISMS,
C-1336-76	OIL SPILLS, CLEANUP, *PHOTOSENSITIZER CHEMICALS,
C-1337-76	OIL SPILLS, RECOVERY, ABSORPTION, DESIGN AND ENGINEERING,
C-1339-76	OIL SPILLS, CLEANUP, HARBORS, JAPAN,
C-1340-76	OIL SPILLS, ARCTIC, DETECTION, CLEANUP, DISPOSAL ,
C-1341-76	OIL SPILLS, RECOVERY, ABSORPTION,
C-1342-76	OIL SPILLS, RECOVERY, SKIMMERS, BEAUFORT SEA, DESIGN AND ENGINEERING,
C-1343-76	OIL SPILLS, RECOVERY, OIL-WATER SEPARATION, SKIMMERS,
C-1344-76	OIL SPILLS, RECOVERY, ABSORPTION, DESIGN AND ENGINEERING,
C-1345-76	OIL SPILLS, RECOVERY, ABSORPTION, *POLYURETHANE CHIPS,
C-1348-76	OIL SPILLS, SKIMMERS, RECOVERY, DESIGN AND ENGINEERING,
C-1349-76	OIL SPILLS, CLEANUP, ABSORPTION,
C-1350-76	OIL SPILLS, RECOVERY, CONTAINMENT, DESIGN AND ENGINEERING,
C-1351-76	OIL SPILLS, RECOVERY, SKIMMERS, BOOMS,
C-1352-76	OIL SPILLS, RECOVERY, DESIGN AND ENGINEERING,
C-1353-76	OIL SPILLS, RECOVERY, DESIGN AND ENGINEERING,
C-1354-76	OIL SPILLS, SKIMMERS, CLEANUP, RECOVERY,
C-1356-76	OIL SPILLS, RECOVERY, SKIMMERS, *TESTING,
C-1357-76	OIL SPILLS, RECOVERY, SKIMMERS, DESIGN AND ENGINEERING, PUGET SOUND,
C-1359-76	OIL SPILLS, CLEANUP, ABSORPTION, *OLEOPHILIC POLYURETHANE FOAMS,
C-1360-76	OIL SPILLS, RECOVERY, DESIGN AND ENGINEERING,
C-1362-76	OIL SPILLS, SKIMMERS, DESIGN AND ENGINEERING, CLEANUP,
C-1364-76	OIL SPILLS, RECOVERY, ABSORPTION, *URETHANE FOAM,
C-1365-76	OIL SPILLS, DISPERSANTS, CLEANUP,
C-1366-76	OIL SPILLS, RECOVERY, OIL SLICKS, DESIGN AND ENGINEERING,
C-1367-76	OIL SPILLS, REMOTE SENSING, RECOVERY, SOURCE IDENTIFICATIONS, DESIGN AND ENGINEERING,
C-1368-76	OIL SPILLS, RECOVERY, SKIMMERS, DESIGN AND ENGINEERING,
C-1369-76	OIL SPILLS, RECOVERY, DESIGN AND ENGINEERING,
C-1370-76	OIL SPILLS, RECOVERY, SKIMMERS, DESIGN AND ENGINEERING,
C-1372-76	OIL SPILLS, CLEANUP, RECOVERY, CONTINGENCY PLANNING,
C-1373-76	OIL SPILLS, CLEANUP, DISPERSANTS, OIL SLICKS, *DETERGENTS,
C-1379-76	OIL SPILLS, SINKING AGENTS, RECOVERY,
C-1380-76	OIL SPILLS, CLEANUP, BOOMS, SKIMMERS, DISPERSANTS,
C-1381-76	OIL SPILLS, RECOVERY, WASTE OIL, SHIPS, ABSORPTION, *LIPOPHILIC FIBERS,

C-1382-76	OIL SPILLS, ABSORPTION, CLEANUP, RECOVERY, *PEAT FIBERS,
C-1383-76	OIL SPILLS, RECOVERY, DESIGN AND ENGINEERING, *EQUIPMENT TESTING,
C-1384-76	OIL SPILLS, RECOVERY, SKIMMERS, DESIGN AND ENGINEERING, *EQUIPMENT TESTING,
C-1385-76	OIL SPILLS, INLAND, ARCTIC, CONTINGENCY PLANNING, CLEANUP, DISPOSAL ,
C-1387-76	OIL SPILLS, POLLUTION PREVENTION, GOVERNMENT AGENCIES, RECOVERY, CLEANUP, OIL DISCHARGES,
C-1390-76	OIL SPILLS, DISPERSIONS, BIODEGRADATION, SURFACTANTS, *ILLUMINATION,
C-1391-76	OIL SPILLS, CLEANUP, EMULSIFICATION, TOXICITY, MARINE ORGANISMS,
C-1392-76	OIL SPILLS, CLEANUP, EMULSIFICATION, *DETERGENTS,
C-1395-76	OIL SPILLS, CLEANUP, RECOVERY, ABSORPTION, *COTTON WASTES,
C-1397-76	OIL SPILLS, RECOVERY, SKIMMERS, DESIGN AND ENGINEERING,
C-1398-76	OIL SPILLS, DISPERSANTS, *SAFETY,
C-1399-76	OIL SPILLS, CLEANUP, CRUDE OIL, ABSORPTION,
C-1401-76	OIL SPILLS, CLEANUP, CONTAINMENT, *POLYMERIZATION,
C-1402-76	OIL SPILLS, CLEANUP, OIL SLICKS, ADSORPTION,
C-1403-76	OIL SPILLS, DESIGN AND ENGINEERING, CLEANUP, RECOVERY, *WAVE DAMPING,
C-1405-76	OIL SPILLS, CLEANUP, RECOVERY, DESIGN AND ENGINEERING,
C-1406-76	OIL SPILLS, POLLUTION PREVENTION, CLEANUP, RECOVERY, CANADA,
C-1408-76	OIL SPILLS, DESIGN AND ENGINEERING, RECOVERY, *U.S. COAST GUARD,
C-1409-76	OIL SPILLS, RECOVERY, DESIGN AND ENGINEERING,
C-1410-76	OIL SPILLS, RECOVERY, SKIMMERS, BOOMS, DESIGN AND ENGINEERING, *EQUIPMENT TESTING,
C-1342-76	OIL SPILLS, CLEANUP, RECOVERY, ABSORPTION,
C-1413-76	OIL SPILLS, CONTAINMENT, RECOVERY, STREAMS, HARBORS,
C-1414-76	OIL SPILLS, CLEANUP, DESIGN AND ENGINEERING, OIL-WATER SEPARATION,
C-1415-76	OIL SPILLS, RECOVERY, ABSORPTION, *FERROMAGNETIC SORBENTS,
C-1416-76	OIL SPILLS, CLEANUP, POLLUTION PREVENTION, INDUSTRY, GOVERNMENT AGENCIES,
C-1417-76	OIL SPILLS, CLEANUP, CONTINGENCY PLANNING, INDUSTRIES,
C-1419-76	OIL SPILLS, RECOVERY, ABSORPTION, COAGULATION,
C-1420-76	OIL SPILLS, RESTORATION, SOIL, CLEANUP, BIODEGRADATION,
C-1422-76	OIL SPILLS, OIL TRANSFER, TANKERS, BANTRY BAY, POLLUTION PREVENTION,
C-1425-76	OIL SPILLS, OIL TRANSFER, OFFSHORE-DEVELOPMENT, WASHINGTON,
C-1427-76	OIL SPILLS, OIL TRANSPORT, STORAGE, ALASKA/GULF OF, OCS,
C-1428-76	OIL SPILLS, OIL TRANSPORT, CALIFORNIA, OCS,
C-1429-76	OIL SPILLS, OIL TRANSPORT, TANKERS, SHIPS, PIPELINES, *RISK ANALYSIS,
C-1433-76	OIL SPILLS, OIL TRANSPORT, *ENVIRONMENTAL RISKS,

C-1434-76	OIL SPILLS, ENVIRONMENTAL EFFECTS, TANKERS, PORTS, BAHAMAS,
C-1438-76	OIL SPILLS, TANKERS, OIL TRANSPORT, *CAPE SEA ROUTE,
C-1441-76	OIL SPILLS, TANKERS, OIL TRANSPORT, DESIGN AND ENGINEERING, POLLUTION PREVENTION,
C-1442-76	OIL SPILLS, TANKERS, *ICEBERGS,
C-1447-76	OIL SPILLS, DESIGN AND ENGINEERING, MANUALS, GUIDELINES, WASTE OIL DISPOSAL , WASTEWATER TREATMENT,
C-1448-76	OIL SPILLS, DESIGN AND ENGINEERING, MANUALS, WASTEWATER TREATMENT, BILGES, EIS,
C-1457-76	OIL SPILLS, DESIGN AND ENGINEERING, INFORMATION SYSTEMS, OFFSHORE-EXPLORATION,
C-1458-76	OIL SPILLS, DESIGN AND ENGINEERING, CLEANUP, RECOVERY,
C-1463-76	OIL SPILLS, WASTEWATER TREATMENT, WATER QUALITY, GROUNDWATER,
C-1493-76	OIL SPILLS, WASTE OIL TREATMENT, *SOLIDIFICATION,
C-1559-76	OIL SPILLS, PERSONNEL TRAINING, CLEANUP,
C-1560-76	OIL SPILLS, PERSONNEL TRAINING, POLLUTION PREVENTION, CLEANUP, CONTINGENCY PLANNING, REGULATIONS,
C-1561-76	OIL SPILLS, CONTINGENCY PLANNING, ALASKA/GULF OF, PERSONNEL TRAINING, CLEANUP, *PORT OF VALDEZ,
C-1562-76	OIL SPILLS, CONTINGENCY PLANNING, POLLUTION PREVENTION, GOVERNMENT AGENCIES,
C-1563-76	OIL SPILLS, CONTINGENCY PLANNING, POLLUTION PREVENTION, PERSONNEL TRAINING,
C-1564-76	OIL SPILLS, CONTINGENCY PLANNING, INLAND, GUIDELINES, CLEANUP,
C-1565-76	OIL SPILLS, CONTINGENCY PLANNING, INLAND, GREAT LAKES ,
C-1566-76	OIL SPILLS, CONTINGENCY PLANNING, PERSONNEL TRAINING, CLEANUP, DISPERSANTS,
C-1574-76	OIL SPILLS, CLEANUP, TOXICITY, CRUDE OIL, DISPERSANTS, CORAL REEFS,
C-1577-76	OIL SPILLS, BIOLOGICAL EFFECTS, BIRDS, CONTINGENCY PLANNING, PERSONNEL TRAINING,
C-1578-76	OIL SPILLS, BIOLOGICAL EFFECTS, PLANTS, ALGAE,
C-1580-76	OIL SPILLS, TOXICITY, EMULSIFIERS, MARINE ORGANISMS,
C-1585-76	OIL SPILLS, BIOLOGICAL EFFECTS, OIL WELLS, BIRDS,
C-1593-76	OIL SPILLS, BIOLOGICAL EFFECTS, WASTEWATER, REFINERIES, MOLLUSKS, KOREA, SOUTH,
C-1595-76	OIL SPILLS, OIL TRANSPORT, OIL SLICKS, ENVIRONMENTAL EFFECTS, CALIFORNIA, NEW YORK,
C-1596-76	OIL SPILLS, ENVIRONMENTAL EFFECTS, LAKES, CANADA, ARCTIC, BIOLOGICAL EFFECTS,
C-1597-76	OIL SPILLS, ENVIRONMENTAL PROTECTION, PETROLEUM INDUSTRY,
C-1599-76	OIL SPILLS, FRESHWATER, GROUNDWATER, ENVIRONMENTAL EFFECTS,
C-1600-76	OIL SPILLS, ENVIRONMENTAL EFFECTS,
C-1601-76	OIL SPILLS, ENVIRONMENTAL EFFECTS, POLLUTION PREVENTION, OFFSHORE-PRODUCTION, TANKERS, LIABILITY,
C-1604-76	OIL SPILLS, BIOLOGICAL EFFECTS, PHYSICAL EFFECTS, COASTS, BEAUFORT SEA, *GEOLOGIC STUDIES,

C-1615-76	OIL SPILLS, MODELS, SOCIO-ECONOMIC EFFECTS, ENVIRONMENTAL EFFECTS, OFFSHORE-PRODUCTION,
C-1631-76	OIL SPILLS, SANTA BARBARA CHANNEL, OFFSHORE-DRILLING, EIS,
C-1637-76	OIL SPILLS, HYDROCARBONS, OFFSHORE-PRODUCTION, LOUISIANA, BIOLOGICAL EFFECTS, ANALYTICAL TECHNIQUES,
C-1649-76	OIL SPILLS, OFFSHORE-DEVELOPMENT, SANTA BARBARA CHANNEL, NATURAL SEEPAGE,
C-1656-76	OIL SPILLS, OFFSHORE-EXPLORATION, GEORGES BANK, ECONOMIC EFFECTS, FISHES,
C-1666-76	OIL SPILLS, BIODEGRADATION, HYDROCARBONS, BACTERIA,
C-1667-76	OIL SPILLS, BIODEGRADATION, CLEANUP, BACTERIA,
C-1700-76	OIL SPILLS, MOVEMENT, BIBLIOGRAPHIES, SPREADING, CLEANUP, DECOMPOSITION,
C-1702-76	OIL SPILLS, ENVIRONMENTAL EFFECTS, PORTS, BAHAMAS, CANADA,
C-1704-76	OIL SPILLS, ENVIRONMENTAL EFFECTS, *BENZENE,
C-1705-76	OIL SPILLS, INLAND, TOXICITY, BIODEGRADATION,
C-1709-76	OIL SPILLS, ENVIRONMENTAL EFFECTS, BIOLOGICAL EFFECTS, MARINE ORGANISMS, SHORELINES,
C-1710-76	OIL SPILLS, BIOLOGICAL EFFECTS, MARINE ORGANISMS,
C-1712-76	OIL SPILLS, MODELS, NORTH SEA, CONTINGENCY PLANNING,
C-1714-76	OIL SPILLS, DECOMPOSITION, FUEL OIL, WEATHERING, SOIL,
C-1717-76	OIL SPILLS, U.S. GOVERNMENT, LEGISLATION, OFFSHORE-DEVELOPMENT, OCS, ENVIRONMENTAL PROTECTION, LIABILIT
C-1722-76	OIL SPILLS, INTERNATIONAL AGREEMENTS, MEDITERRANEAN SEA, OIL DISCHARGES,
C-1723-76	OIL SPILLS, INTERNATIONAL CONVENTIONS, LIABILITY,
C-1724-76	OIL SPILLS, INTERNATIONAL AGREEMENTS, LIABILITY, NORTH SEA,
C-1726-76	OIL SPILLS, INTERNATIONAL CONVENTIONS, OIL TRANSPORT, POLLUTION PREVENTION, TANKERS,
C-1736-76	OIL SPILLS, CLEANUP, INTERNATIONAL CONVENTIONS, ENVIRONMENTAL PROTECTION, *SAFETY STANDARDS,
C-1738-76	OIL SPILLS, BIBLIOGRAPHIES, BIODEGRADATION, DECOMPOSITION, CLEANUP,
C-1739-76	OIL SPILLS, BIBLIOGRAPHIES, BIOLOGICAL EFFECTS, ENVIRONMENTAL EFFECTS
C-1320-76	OIL TRANSFER, CONTAINMENT, OIL SPILLS, HARBORS, *BUBBLE BARRIER,
C-1422-76	OIL TRANSFER, TANKERS, OIL SPILLS, BANTRY BAY, POLLUTION PREVENTION,
C-1425-76	OIL TRANSFER, OFFSHORE-DEVELOPMENT, WASHINGTON, OIL SPILLS,
C-1432-76	OIL TRANSFER, POLLUTION PREVENTION, OIL DISCHARGES, PERSONNEL TRAINING, MONITORING,
C-1440-76	OIL TRANSFER, DESIGN AND ENGINEERING, TANKERS, PORTS, POLLUTION PREVENTION,
C-1241-76	OIL TRANSPORT, TANKERS, ALASKA/GULF OF, *GLACIAL RETREAT,
C-1250-76	OIL TRANSPORT, OIL SPILLS, PIPELINES, EUROPE, CLEANUP,
C-1427-76	OIL TRANSPORT, STORAGE, ALASKA/GULF OF, OCS, OIL SPILLS,

C-1428-76	OIL TRANSPORT, CALIFORNIA, OCS, OIL SPILLS,
C-1429-76	OIL TRANSPORT, TANKERS, SHIPS, PIPELINES, OIL SPILLS, *RISK ANALYSIS,
C-1430-76	OIL TRANSPORT, PETROLEUM INDUSTRY, TANKERS, POLLUTION PREVENTION,
C-1431-76	OIL TRANSPORT, TANKERS, DESIGN AND ENGINEERING,
C-1433-76	OIL TRANSPORT, OIL SPILLS, *ENVIRONMENTAL RISKS,
C-1436-76	OIL TRANSPORT, TANKERS, INLAND, POLLUTION PREVENTION, DESIGN AND ENGINEERING,
C-1438-76	OIL TRANSPORT, TANKERS, OIL SPILLS, *CAPE SEA ROUTE,
C-1441-76	OIL TRANSPORT, TANKERS, OIL SPILLS, DESIGN AND ENGINEERING, POLLUTION PREVENTION,
C-1446-76	OIL TRANSPORT, CRUDE OIL, TANKERS, ENVIRONMENTAL PROTECTION,
C-1567-76	OIL TRANSPORT, CONTINGENCY PLANNING, PERSONNEL TRAINING, OIL DISCHARGES,
C-1595-76	OIL TRANSPORT, OIL SLICKS, ENVIRONMENTAL EFFECTS, OIL SPILLS, CALIFORNIA, NEW YORK, EXPLORATION, OFFSHORE-PRODUCTION, NORTH SEA,
C-1720-76	OIL TRANSPORT, REGULATIONS, POLLUTION PREVENTION, TANKERS,
C-1734-76	OIL TRANSPORT, GUIDELINES, POLLUTION PREVENTION, GROUNDWATER, STORAGE, EUROPE,
C-1281-76	OIL-WATER SEPARATION, SAMPLING, CRUDE OIL, *CENTRIFUGATION,
C-1343-76	OIL-WATER SEPARATION, OIL SPILLS, RECOVERY, SKIMMERS,
C-1374-76	OIL-WATER SEPARATION, WASTEWATER TREATMENT, EMULSIONS, COAGULATION,
C-1414-76	OIL-WATER SEPARATION, CLEANUP, OIL SPILLS, DESIGN AND ENGINEERING,
C-1418-76	OIL-WATER SEPARATION, OIL SLICKS, SKIMMERS, DESIGN AND ENGINEERING,
C-1452-76	OIL-WATER SEPARATION, DESIGN AND ENGINEERING, POLLUTION PREVENTION, BALLAST,
C-1456-76	OIL-WATER SEPARATION, DESIGN AND ENGINEERING,
C-1460-76	OIL-WATER SEPARATION, WASTEWATER TREATMENT, EMULSIONS,
C-1461-76	OIL-WATER SEPARATION, WASTEWATER TREATMENT, SLUDGE, SOLVENTS, DISTILLATION, PRODUCTION, RECOVERY,
C-1465-76	OIL-WATER SEPARATION, WASTEWATER TREATMENT, BILGES,
C-1467-76	OIL-WATER SEPARATION, WASTEWATER TREATMENT, ADSORPTION,
C-1470-76	OIL-WATER SEPARATION, WASTEWATER TREATMENT, EMULSIONS, FLOCCULATION,
C-1471-76	OIL-WATER SEPARATION, WASTEWATER TREATMENT, DESIGN AND ENGINEERING, ADSORPTION,
C-1472-76	OIL-WATER SEPARATION, WASTEWATER TREATMENT, *ELECTROLYSIS,
C-1475-76	OIL-WATER SEPARATION, WASTEWATER TREATMENT, EMULSIONS, COALESCENCE,
C-1481-76	OIL-WATER SEPARATION, WASTEWATER TREATMENT, REFINERIES, ECONOMIC EFFECTS,
C-1484-76	OIL-WATER SEPARATION, REFINERIES, WASTEWATER TREATMENT, FILTRATION, FLOCCULATION,

C-1487-76	OIL-WATER SEPARATION, SHIPS, COALESCENCE, DESIGN AND ENGINEERING,
C-1488-76	OIL-WATER SEPARATION, WASTEWATER TREATMENT, WASTE OIL TREATMENT, LUBRICATING OILS,
C-1491-76	OIL-WATER SEPARATION, WASTEWATER TREATMENT, EMULSIONS, COALESCENCE,
C-1492-76	OIL-WATER SEPARATION, WASTEWATER TREATMENT, ADSORPTION,
C-1494-76	OIL-WATER SEPARATION, WASTEWATER TREATMENT, FLOCCULATION, ADSORPTION,
C-1496-76	OIL-WATER SEPARATION, WASTEWATER TREATMENT, SHIPS, *SURFACE CHEMISTRY PARAMETERS,
C-1497-76	OIL-WATER SEPARATION, WASTEWATER TREATMENT, EMULSIONS, FLOCCULATION,
C-1499-76	OIL-WATER SEPARATION, WASTEWATER TREATMENT, FLOCCULATION, FILTRATION,
C-1500-76	OIL-WATER SEPARATION, WASTEWATER TREATMENT, EMULSIONS, FLOCCULATION,
C-1502-76	OIL-WATER SEPARATION, WASTEWATER TREATMENT, FLOCCULATION, FILTRATION,
C-1503-76	OIL-WATER SEPARATION, WASTEWATER TREATMENT, FLOCCULATION, FLOTATION,
C-1504-76	OIL-WATER SEPARATION, WASTEWATER TREATMENT, EMULSIONS, COALESCENCE,
C-1507-76	OIL-WATER SEPARATION, WASTEWATER TREATMENT, *VACUUM STRIPPING,
C-1508-76	OIL-WATER SEPARATION, WASTEWATER TREATMENT, ADSORPTION,
C-1512-76	OIL-WATER SEPARATION, WASTEWATER TREATMENT, FLOCCULATION, FILTRATION, DESIGN AND ENGINEERING,
C-1513-76	OIL-WATER SEPARATION, *WELL CUTTINGS DISPOSAL , OFFSHORE-DRILLING, DESIGN AND ENGINEERING,
C-1515-76	OIL-WATER SEPARATION, WASTEWATER TREATMENT,
C-1516-76	OIL-WATER SEPARATION, WASTEWATER TREATMENT, DESIGN AND ENGINEERING,
C-1517-76	OIL-WATER SEPARATION, WASTEWATER TREATMENT,
C-1518-76	OIL-WATER SEPARATION, WASTEWATER TREATMENT, REFINERIES, FLOTATION, EMULSIONS,
C-1519-76	OIL-WATER SEPARATION, WASTEWATER TREATMENT, BILGES, FILTRATION,
C-1520-76	OIL-WATER SEPARATION, WASTEWATER TREATMENT, ADSORPTION, *MAGNETIC FE PARTICLES,
C-1524-76	OIL-WATER SEPARATION, WASTEWATER TREATMENT, SHIPS, REUSE,
C-1528-76	OIL-WATER SEPARATION, WASTEWATER TREATMENT, DESIGN AND ENGINEERING, ABSORPTION,
C-1531-76	OIL-WATER SEPARATION, WASTEWATER TREATMENT, EMULSIONS, FLOCCULATION,
C-1535-76	OIL-WATER SEPARATION, WASTEWATER TREATMENT, REFINERIES, FLOTATION, FLOCCULATION,
C-1536-76	OIL-WATER SEPARATION, WASTEWATER TREATMENT, ABSORPTION,
C-1537-76	OIL-WATER SEPARATION, WASTEWATER TREATMENT, CRUDE OIL, HYDROCARBONS, *POLYETHYLENE POWDER,
C-1538-76	OIL-WATER SEPARATION, WASTEWATER TREATMENT, ADSORPTION,

C-1541-76	OIL-WATER SEPARATION, WASTEWATER TREATMENT, FLOCCULATION,
C-1285-76	OIL WELLS, SAMPLING, CHEMICAL ANALYSIS, NATURAL SEEPAGE, ALASKA/GULF OF,
C-1453-76	OIL WELLS, DESIGN AND ENGINEERING, BLOWOUT PREVENTION,
C-1454-76	OIL WELLS, DESIGN AND ENGINEERING, BLOWOUT PREVENTION, OFFSHORE-DRILLING,
C-1501-76	OIL WELLS, WASTEWATER TREATMENT, WASTEWATER DISPOSAL , RECYCLING,
C-1585-76	OIL WELLS, BIOLOGICAL EFFECTS, OIL SPILLS, BIRDS,
C-1651-76	OIL WELLS, OFFSHORE-PRODUCTION, LEAKAGE, BLOWOUT PREVENTION,
C-1657-76	OIL WELLS, DRILLING, POLLUTION PREVENTION, VENEZUELA,
C-1505-76	OXIDATION, WASTEWATER TREATMENT, REFINERIES,
C-1672-76	OXIDATION, BIODEGRADATION, HYDROCARBONS, CRUDE OIL, FUNGI, BACTERIA,
C-1677-76	OXIDATION, BIODEGRADATION, HYDROCARBONS, STREAMS, BACTERIA, *ARTHROBACTER SP., *MYCOBACTERIUM SP.,
C-1689-76	OXIDATION, HYDROCARBONS, FUNGI, *CLADOSPORIUM RESINAE,
C-1282-76	PACIFIC OCEAN, SAMPLING, HYDROCARBONS, *TANKER ROUTES,
C-1432-76	PERSONNEL TRAINING, OIL TRANSFER, POLLUTION PREVENTION, OIL DISCHARGES, MONITORING,
C-1559-76	PERSONNEL TRAINING, OIL SPILLS, CLEANUP,
C-1560-76	PERSONNEL TRAINING, POLLUTION PREVENTION, OIL SPILLS, CLEANUP, CONTINGENCY PLANNING, REGULATIONS,
C-1561-76	PERSONNEL TRAINING, CONTINGENCY PLANNING, OIL SPILLS, ALASKA/GULF OF, CLEANUP, *PORT OF VALDEZ,
C-1563-76	PERSONNEL TRAINING, CONTINGENCY PLANNING, OIL SPILLS, POLLUTION PREVENTION,
C-1566-76	PERSONNEL TRAINING, CONTINGENCY PLANNING, OIL SPILLS, CLEANUP, DISPERSANTS,
C-1567-76	PERSONNEL TRAINING, CONTINGENCY PLANNING, OIL TRANSPORT, OIL DISCHARGES,
C-1733-76	PERSONNEL TRAINING, GUIDELINES, GERMANY, WEST, POLLUTION PREVENTION, REGULATIONS,
C-1473-76	PETROCHEMICALS, WASTE OIL DISPOSAL , DISPERSIONS,
C-1509-76	PETROCHEMICALS, WASTEWATER TREATMENT, ACTIVATED SLUDGE ,
C-1514-76	PETROCHEMICALS, WASTEWATER TREATMENT, ADSORPTION, *ACTIVATED CARBON,
C-1527-76	PETROCHEMICALS, MODELS, WASTEWATER TREATMENT, ECONOMIC EFFECTS, *OLEFIN PRODUCTION,
C-1542-76	PETROCHEMICALS, REUSE,
C-1570-76	PETROCHEMICALS, TOXICITY, HEALTH HAZARDS, *LIQUID MEMBRANES,
C-1582-76	PETROCHEMICALS, BIOLOGICAL EFFECTS, SOIL, MICROORGANISMS, PLANTS,
C-1608-76	PETROCHEMICALS, ENVIRONMENTAL EFFECTS, BIOLOGICAL EFFECTS, WASTEWATER DISPOSAL ,
C-1665-76	PETROCHEMICALS, BIODEGRADATION, MICROORGANISMS, *DEGRADATION INHIBITORS,
C-1675-76	PETROCHEMICALS, BIODEGRADATION, ANALYTICAL TECHNIQUES,
C-1240-76	PETROLEUM INDUSTRY, OIL SPILLS, ALASKA/GULF OF, OFFSHORE-DEVELOPMENT,

C-1430-76 PETROLEUM INDUSTRY, OIL TRANSPORT, TANKERS, POLLUTION PREVENTION,
C-1444-76 PETROLEUM INDUSTRY, REGULATIONS, POLLUTION PREVENTION, TANKERS, INTERNATIONAL CONVENTIONS,
C-1525-76 PETROLEUM INDUSTRY, GUIDELINES, REFINERIES, WASTEWATER TREATMENT,
C-1597-76 PETROLEUM INDUSTRY, ENVIRONMENTAL PROTECTION, OIL SPILLS,
C-1650-76 PETROLEUM INDUSTRY, ENVIRONMENTAL EFFECTS, PRODUCTION, JAPAN,
C-1718-76 PETROLEUM INDUSTRY, LEGISLATION, EIS, INDUSTRIES,
C-1721-76 PETROLEUM INDUSTRY, LEGISLATION, REFINING, ECONOMIC EFFECTS,
C-1737-76 PETROLEUM INDUSTRY, REGULATIONS, PIPELINES, WASTEWATER TREATMENT, EUROPE,
C-1243-76 PHYSICAL EFFECTS, OFFSHORE-EXPLORATION, BIOLOGICAL EFFECTS, FISHERIES,
C-1604-76 PHYSICAL EFFECTS, BIOLOGICAL EFFECTS, OIL SPILLS, COASTS, BEAUFORT SEA, *GEOLOGIC STUDIES,
C-1695-76 PHYSICAL EFFECTS, CHEMICAL EFFECTS, DISPERSIONS, WEATHERING, CHEMICAL ANALYSIS, CRUDE OIL,
C-1584-76 PHYTOPLANKTON, CRUDE OIL, FUEL OIL, BIOLOGICAL EFFECTS, ALGAE,
C-1250-76 PIPELINES, OIL SPILLS, OIL TRANSPORT, EUROPE, CLEANUP,
C-1338-76 PIPELINES, DISPERSANTS, CLEANUP, WASTEWATER TREATMENT,
C-1429-76 PIPELINES, OIL TRANSPORT, TANKERS, SHIPS, OIL SPILLS, *RISK ANALYSIS,
C-1737-76 PIPELINES, PETROLEUM INDUSTRY, REGULATIONS, WASTEWATER TREATMENT, EUROPE,
C-1584-76 PLANKTON, CRUDE OIL, FUEL OIL, BIOLOGICAL EFFECTS, PHYTOALGAE,
C-1568-76 PLANTS, BIOLOGICAL EFFECTS, MICROORGANISMS, SOIL, CRUDE OIL, FUEL OIL,
C-1578-76 PLANTS, BIOLOGICAL EFFECTS, OIL SPILLS, ALGAE,
C-1582-76 PLANTS, BIOLOGICAL EFFECTS, PETROCHEMICALS, SOIL, MICROORGANISMS,
C-1253-76 POLLUTION PREVENTION, MONITORING, DESIGN AND ENGINEERING, INTERNATIONAL CONVENTIONS,
C-1333-76 POLLUTION PREVENTION, CLEANUP, OCS, ARCTIC, BIBLIOGRAPHIES,
C-1363-76 POLLUTION PREVENTION, CLEANUP, INDUSTRIES, INTERNATIONAL AGREEMENTS,
C-1387-76 POLLUTION PREVENTION, GOVERNMENT AGENCIES, OIL SPILLS, RECOVERY, CLEANUP, OIL DISCHARGES,
C-1406-76 POLLUTION PREVENTION, OIL SPILLS, CLEANUP, RECOVERY, CANADA,
C-1416-76 POLLUTION PREVENTION, OIL SPILLS, CLEANUP, INDUSTRY, GOVERNMENT AGENCIES,
C-1422-76 POLLUTION PREVENTION, OIL TRANSFER, TANKERS, OIL SPILLS, BANTRY BAY,
C-1424-76 POLLUTION PREVENTION, EIS, REGULATIONS, TANKERS, DESIGN AND ENGINEERING,

C-1430-76 POLLUTION PREVENTION, OIL TRANSPORT, PETROLEUM INDUSTRY, TANKERS,
C-1432-76 POLLUTION PREVENTION, OIL TRANSFER, OIL DISCHARGES, PERSONNEL TRAINING, MONITORING,
C-1435-76 POLLUTION PREVENTION, TANKERS, LOAD-ON-TOP, OIL DISCHARGES,
C-1436-76 POLLUTION PREVENTION, OIL TRANSPORT, TANKERS, INLAND, DESIGN AND ENGINEERING,
C-1437-76 POLLUTION PREVENTION, TANKERS, REGULATIONS,
C-1440-76 POLLUTION PREVENTION, OIL TRANSFER, DESIGN AND ENGINEERING, TANKERS, PORTS,
C-1441-76 POLLUTION PREVENTION, TANKERS, OIL TRANSPORT, OIL SPILLS, DESIGN AND ENGINEERING,
C-1444-76 POLLUTION PREVENTION, REGULATIONS, TANKERS, INTERNATIONAL CONVENTIONS, PETROLEUM INDUSTRY,
C-1445-76 POLLUTION PREVENTION, PORTS, TANKERS, SHIPS,
C-1452-76 POLLUTION PREVENTION, DESIGN AND ENGINEERING, BALLAST, OIL-WATER SEPARATION,
C-1522-76 POLLUTION PREVENTION, REFINERIES, WASTEWATER TREATMENT, WASTEWATER DISPOSAL ,
C-1560-76 POLLUTION PREVENTION, PERSONNEL TRAINING, OIL SPILLS, CLEANUP, CONTINGENCY PLANNING, REGULATIONS,
C-1562-76 POLLUTION PREVENTION, CONTINGENCY PLANNING, OIL SPILLS, GOVERNMENT AGENCIES,
C-1563-76 POLLUTION PREVENTION, CONTINGENCY PLANNING, OIL SPILLS, PERSONNEL TRAINING,
C-1594-76 POLLUTION PREVENTION, ECONOMIC EFFECTS, REGULATIONS,
C-1601-76 POLLUTION PREVENTION, ENVIRONMENTAL EFFECTS, OIL SPILLS, OFFSHORE-PRODUCTION, TANKERS, LIABILITY,
C-1610-76 POLLUTION PREVENTION, REFINERIES,
C-1618-76 POLLUTION PREVENTION, ECONOMIC EFFECTS, REGULATIONS, OFFSHORE DEVELOPMENT, LEGISLATION, PRODUCTION, MEXICO/GULF OF, DESIGN AND ENGINEERING,
C-1644-76 POLLUTION PREVENTION, OFFSHORE-EXPLORATION, CANADA, *LABRADOR,
C-1657-76 POLLUTION PREVENTION, DRILLING, OIL WELLS, VENEZUELA,
C-1692-76 POLLUTION PREVENTION, BIODEGRADATION, HYDROCARBONS, MICROORGANISMS, TOXICITY,
C-1715-76 POLLUTION PREVENTION, LEGISLATION, *LITIGATION,
C-1720-76 POLLUTION PREVENTION, REGULATIONS, TANKERS, OIL TRANSPORT,
C-1726-76 POLLUTION PREVENTION, INTERNATIONAL CONVENTIONS, OIL TRANSPORT, TANKERS, OIL SPILLS,
C-1727-76 POLLUTION PREVENTION, INTERNATIONAL CONVENTIONS, LAW ENFORCEMENT, TANKERS, MONITORING, OIL DISCHARGES,
C-1728-76 POLLUTION PREVENTION, INTERNATIONAL CONVENTIONS, OIL DISCHARGES, *INTERNATIONAL LAW COMMISSION,
C-1730-76 POLLUTION PREVENTION, INTERNATIONAL CONVENTIONS, SHIPS, TANKERS, OIL DISCHARGES,
C-1733-76 POLLUTION PREVENTION, GUIDELINES, GERMANY, WEST, REGULATIONS, PERSONNEL TRAINING,
C-1734-76 POLLUTION PREVENTION, GUIDELINES, GROUNDWATER, OIL TRANSPORT, STORAGE, EUROPE,

C-1735-76 POLLUTION PREVENTION, GUIDELINES, COASTS, INDONESIA, BIBLIOGRAPHIES,
C-1303-76 PORTS, STATISTICAL ANALYSIS, OIL SPILLS, TANKERS, ENVIRONMENTAL EFFECTS, MODELS,
C-1434-76 PORTS, ENVIRONMENTAL EFFECTS, TANKERS, BAHAMAS, OIL SPILLS,
C-1440-76 PORTS, OIL TRANSFER, DESIGN AND ENGINEERING, TANKERS, POLLUTION PREVENTION,
C-1445-76 PORTS, POLLUTION PREVENTION, TANKERS, SHIPS,
C-1702-76 PORTS, ENVIRONMENTAL EFFECTS, OIL SPILLS, BAHAMAS, CANADA,
C-1527-76 PRODUCTION, MODELS, WASTEWATER TREATMENT, ECONOMIC EFFECTS, PETROCHEMICALS, *OLEFIN
C-1632-76 PRODUCTION, OIL SHALE DEVELOPMENT, USSR, ENVIRONMENTAL EFFECTS,
C-1635-76 PRODUCTION, ENVIRONMENTAL EFFECTS, TAR SANDS, CANADA,
C-1650-76 PRODUCTION, ENVIRONMENTAL EFFECTS, PETROLEUM INDUSTRY, JAPAN,
C-1652-76 PRODUCTION, EIS, OIL SHALE DEVELOPMENT, TAR SANDS, ENVIRONMENTAL EFFECTS, *WESTERN U.S.,
C-1653-76 PRODUCTION, EIS, OIL SHALE DEVELOPMENT, TAR SANDS, ENVIRONMENTAL EFFECTS, *WESTERN U.S.,
C-1357-76 PUGET SOUND, RECOVERY, OIL SPILLS, SKIMMERS, DESIGN AND ENGINEERING,
C-1543-76 RECLAMATION, WASTE OIL TREATMENT, LUBRICATING OILS,
C-1544-76 RECLAMATION, WASTE OIL TREATMENT, CRUDE OIL, SOLID WASTE, *PYROLYSIS,
C-1545-76 RECLAMATION, WASTE OIL TREATMENT, LUBRICATING OIL, RECYCLING,
C-1546-76 RECLAMATION, RECYCLING, LEGISLATION, U.S. GOVERNMENT, WASTE OIL TREATMENT, WASTE OIL DISPOSAL ,
C-1548-76 RECLAMATION, CRUDE OIL, EXTRACTION, *FLEXICOKING, *RESIDUAL OILS,
C-1549-76 RECLAMATION, WASTE OIL TREATMENT, REFINING,
C-1550-76 RECLAMATION, WASTE OIL TREATMENT,
C-1551-76 RECLAMATION, WASTE OIL TREATMENT, CRANKCASE OIL, LUBRICATING OIL, FUEL OIL,
C-1552-76 RECLAMATION, WASTE OIL TREATMENT, CRANKCASE OIL,
C-1553-76 RECLAMATION, LUBRICATING OIL, WASTE OIL TREATMENT,
C-1555-76 RECLAMATION, WASTE OIL TREATMENT,
C-1556-76 RECLAMATION, WASTE OIL, *EXTRACTION TECHNIQUES,
C-1557-76 RECLAMATION, LUBRICATING OIL, WASTE OIL TREATMENT,
C-1558-76 RECLAMATION, RECYCLING, CRANKCASE OIL, *PYROLIZATION,
C-1334-76 RECOVERY, OIL SPILLS, ABSORPTION,
C-1337-76 RECOVERY, OIL SPILLS, ABSORPTION, DESIGN AND ENGINEERING,
C-1341-76 RECOVERY, OIL SPILLS, ABSORPTION,
C-1342-76 RECOVERY, OIL SPILLS, SKIMMERS, BEAUFORT SEA, DESIGN AND ENGINEERING,
C-1343-76 RECOVERY, OIL SPILLS, OIL-WATER SEPARATION, SKIMMERS,
C-1344-76 RECOVERY, OIL SPILLS, ABSORPTION, DESIGN AND ENGINEERING,
C-1345-76 RECOVERY, OIL SPILLS, ABSORPTION, *POLYURETHANE CHIPS,

C-1346-76	RECOVERY, ABSORPTION, OIL SLICKS,
C-1347-76	RECOVERY, SKIMMERS, OIL SLICKS, REFINERIES,
C-1348-76	RECOVERY, SKIMMERS, OIL SPILLS, DESIGN AND ENGINEERING,
C-1350-76	RECOVERY, OIL SPILLS, CONTAINMENT, DESIGN AND ENGINEERING,
C-1351-76	RECOVERY, OIL SPILLS, SKIMMERS, BOOMS,
C-1352-76	RECOVERY, OIL SPILLS, DESIGN AND ENGINEERING,
C-1353-76	RECOVERY, OIL SPILLS, DESIGN AND ENGINEERING,
C-1354-76	RECOVERY, SKIMMERS, CLEANUP, OIL SPILLS,
C-1356-76	RECOVERY, OIL SPILLS, SKIMMERS, *TESTING,
C-1357-76	RECOVERY, OIL SPILLS, SKIMMERS, DESIGN AND ENGINEERING, PUGET SOUND,
C-1358-76	RECOVERY, OIL SLICKS, SKIMMERS,
C-1360-76	RECOVERY, OIL SPILLS, DESIGN AND ENGINEERING,
C-1361-76	RECOVERY, CONTAINMENT, OIL SLICKS, DESIGN AND ENGINEERING,
C-1364-76	RECOVERY, OIL SPILLS, ABSORPTION, *URETHANE FOAM,
C-1366-76	RECOVERY, OIL SPILLS, OIL SLICKS, DESIGN AND ENGINEERING,
C-1367-76	RECOVERY, OIL SPILLS, REMOTE SENSING, SOURCE IDENTIFICATIONS, DESIGN AND ENGINEERING,
C-1368-76	RECOVERY, OIL SPILLS, SKIMMERS, DESIGN AND ENGINEERING,
C-1369-76	RECOVERY, OIL SPILLS, DESIGN AND ENGINEERING,
C-1370-76	RECOVERY, OIL SPILLS, SKIMMERS, DESIGN AND ENGINEERING,
C-1372-76	RECOVERY, OIL SPILLS, CLEANUP, CONTINGENCY PLANNING,
C-1375-76	RECOVERY, SKIMMERS, DESIGN AND ENGINEERING,
C-1376-76	RECOVERY, SKIMMERS, OIL SLICKS, DESIGN AND ENGINEERING,
C-1377-76	RECOVERY, OIL SLICKS, SKIMMERS, DESIGN AND ENGINEERING,
C-1378-76	RECOVERY, OIL SLICKS, DESIGN AND ENGINEERING, *OIL COLLECTOR,
C-1379-76	RECOVERY, SINKING AGENTS, OIL SPILLS,
C-1381-76	RECOVERY, OIL SPILLS, WASTE OIL, SHIPS, ABSORPTION, *LIPOPHILIC FIBERS,
C-1382-76	RECOVERY, ABSORPTION, OIL SPILLS, CLEANUP, *PEAT FIBERS,
C-1383-76	RECOVERY, OIL SPILLS, DESIGN AND ENGINEERING, *EQUIPMENT TESTING,
C-1384-76	RECOVERY, OIL SPILLS, SKIMMERS, DESIGN AND ENGINEERING, *EQUIPMENT TESTING,
C-1386-76	RECOVERY, OIL SLICKS, DESIGN AND ENGINEERING, *OLEOPHILIC DISCS,
C-1387-76	RECOVERY, POLLUTION PREVENTION, GOVERNMENT AGENCIES, OIL SPILLS, CLEANUP, OIL DISCHARGES,
C-1388-76	RECOVERY, ADSORPTION, CLEANUP, *BAGASSE,
C-1394-76	RECOVERY, OIL SLICKS, SKIMMERS, DESIGN AND ENGINEERING,
C-1395-76	RECOVERY, CLEANUP, OIL SPILLS, ABSORPTION, *COTTON WASTES,
C-1396-76	RECOVERY, OIL SLICKS, BOOMS, DESIGN AND ENGINEERING,
C-1397-76	RECOVERY, OIL SPILLS, SKIMMERS, DESIGN AND ENGINEERING,
C-1403-76	RECOVERY, DESIGN AND ENGINEERING, CLEANUP, OIL SPILLS, *WAVE DAMPING,
C-1404-76	RECOVERY, NATURAL SEEPAGE, DESIGN AND ENGINEERING,
C-1405-76	RECOVERY, OIL SPILLS, CLEANUP, DESIGN AND ENGINEERING,

C-1406-76	RECOVERY, OIL SPILLS, POLLUTION PREVENTION, CLEANUP, CANADA,
C-1407-76	RECOVERY, CLEANUP, MANUALS, DESIGN AND ENGINEERING,
C-1408-76	RECOVERY, DESIGN AND ENGINEERING, OIL SPILLS, *U.S. COAST GUARD,
C-1409-76	RECOVERY, OIL SPILLS, DESIGN AND ENGINEERING,
C-1410-76	RECOVERY, OIL SPILLS, SKIMMERS, BOOMS, DESIGN AND ENGINEERING, *EQUIPMENT TESTING,
C-1411-76	RECOVERY, CLEANUP, OIL SLICKS,
C-1342-76	RECOVERY, OIL SPILLS, CLEANUP, ABSORPTION,
C-1413-76	RECOVERY, CONTAINMENT, OIL SPILLS, STREAMS, HARBORS,
C-1415-76	RECOVERY, OIL SPILLS, ABSORPTION, *FERROMAGNETIC SORBENTS,
C-1419-76	RECOVERY, OIL SPILLS, ABSORPTION, COAGULATION,
C-1458-76	RECOVERY, DESIGN AND ENGINEERING, CLEANUP, OIL SPILLS,
C-1464-76	RECOVERY, WASTEWATER TREATMENT, OIL-WATER SEPARATION, OFFSHORE-PRODUCTION,
C-1485-76	RECOVERY, WASTEWATER TREATMENT, HYDROCARBONS, ADSORPTION,
C-1498-76	RECOVERY, WASTE OIL DISPOSAL , RECYCLING, REUSE,
C-1469-76	RECYCLING, WASTE OIL DISPOSAL , LEGISLATION,
C-1498-76	RECYCLING, WASTE OIL DISPOSAL , RECOVERY, REUSE,
C-1501-76	RECYCLING, OIL WELLS, WASTEWATER TREATMENT, WASTEWATER DISPOSAL ,
C-1511-76	RECYCLING, WASTE OIL DISPOSAL , REUSE,
C-1530-76	RECYCLING, WASTE OIL TREATMENT, SLUDGE, REFINERIES,
C-1545-76	RECYCLING, WASTE OIL TREATMENT, RECLAMATION, LUBRICATING OIL,
C-1546-76	RECYCLING, LEGISLATION, U.S. GOVERNMENT, WASTE OIL TREATMENT, WASTE OIL DISPOSAL , RECLAMATION,
C-1547-76	RECYCLING, WASTE OIL TREATMENT, REFINING, REGULATIONS, LEGISLATION,
C-1554-76	RECYCLING, WASTE OIL TREATMENT, LUBRICATING OILS,
C-1558-76	RECYCLING, RECLAMATION, CRANKCASE OIL, *PYROLIZATION,
C-1576-76	RED SEA, TOXICITY, CRUDE OIL, DISPERSANTS, FISH, INVERTEBRATES,
C-1249-76	REFINERIES, LAW ENFORCEMENT, POLLUTION CONTROL RECORDS,
C-1255-76	REFINERIES, MONITORING, ANALYTICAL TECHNIQUES, HYDROCARBONS, WASTEWATER,
C-1347-76	REFINERIES, SKIMMERS, RECOVERY, OIL SLICKS,
C-1455-76	REFINERIES, DESIGN AND ENGINEERING, ECONOMIC EFFECTS, REGULATIONS,
C-1462-76	REFINERIES, WASTEWATER TREATMENT, SOLID WASTE, *SAFETY ASPECTS LNG,
C-1476-76	REFINERIES, WASTE OIL DISPOSAL , INCINERATION, SLUDGE, EMULSIONS,
C-1477-76	REFINERIES, REGULATIONS, WASTEWATER TREATMENT, *PRIMARY TREATMENT, *SECOND AND TERTIARY TREATMENT,
C-1481-76	REFINERIES, WASTEWATER TREATMENT, ECONOMIC EFFECTS, OIL-WATER SEPARATION,
C-1482-76	REFINERIES, WASTE OIL DISPOSAL , ADSORPTION, ACTIVATED SLUDGE ,

C-1483-76 REFINERIES, GUIDELINES, WASTEWATER, ECONOMIC EFFECTS,
C-1484-76 REFINERIES, WASTEWATER TREATMENT, OIL-WATER SEPARATION, FILTRATION, FLOCCULATION,
C-1490-76 REFINERIES, WASTEWATER TREATMENT, FLOCCULATION, COAGULATION,
C-1505-76 REFINERIES, WASTEWATER TREATMENT, OXIDATION,
C-1506-76 REFINERIES, WASTEWATER TREATMENT, DESIGN AND ENGINEERING, FILTRATION, ADSORPTION,
C-1510-76 REFINERIES, WASTEWATER TREATMENT, ENVIRONMENTAL EFFECTS, FISHERIES,
C-1518-76 REFINERIES, WASTEWATER TREATMENT, OIL-WATER SEPARATION, FLOTATION, EMULSIONS,
C-1521-76 REFINERIES, WASTEWATER TREATMENT, ADSORPTION, DESIGN AND ENGINEERING,
C-1522-76 REFINERIES, WASTEWATER TREATMENT, WASTEWATER DISPOSAL , POLLUTION PREVENTION,
C-1525-76 REFINERIES, GUIDELINES, PETROLEUM INDUSTRY, WASTEWATER TREATMENT,
C-1526-76 REFINERIES, WASTEWATER TREATMENT, USSR, *SARATOV RESERVOIR,
C-1530-76 REFINERIES, WASTE OIL TREATMENT, SLUDGE, RECYCLING,
C-1533-76 REFINERIES, WASTEWATER TREATMENT, MONITORING, WATER QUALITY,
C-1535-76 REFINERIES, WASTEWATER TREATMENT, OIL-WATER SEPARATION, FLOTATION, FLOCCULATION,
C-1539-76 REFINERIES, WASTEWATER TREATMENT,
C-1540-76 REFINERIES, WASTEWATER TREATMENT, WASTE OIL TREATMENT, TANKERS,
C-1593-76 REFINERIES, BIOLOGICAL EFFECTS, OIL SPILLS, WASTEWATER, MOLLUSKS, KOREA, SOUTH,
C-1610-76 REFINERIES, POLLUTION PREVENTION,
C-1616-76 REFINERIES, NEW HAMPSHIRE, SOCIO-ECONOMIC EFFECTS,
C-1628-76 REFINERIES, ENVIRONMENTAL EFFECTS, FISHERIES, VIRGINIA,
C-1684-76 REFINERIES, BIODEGRADATION, WASTEWATER TREATMENT, TOXICITY, MICROORGANISMS,
C-1547-76 REFINING, WASTE OIL TREATMENT, RECYCLING, REGULATIONS, LEGISLATION,
C-1549-76 REFINING, WASTE OIL TREATMENT, RECLAMATION,
C-1721-76 REFINING, LEGISLATION, PETROLEUM INDUSTRY, ECONOMIC EFFECTS,
C-1424-76 REGULATIONS, EIS, TANKERS, DESIGN AND ENGINEERING, POLLUTION PREVENTION,
C-1426-76 REGULATIONS, TANKERS, SEGREGATED BALLAST , *U.S. COAST GUARD,
C-1437-76 REGULATIONS, TANKERS, POLLUTION PREVENTION,
C-1444-76 REGULATIONS, POLLUTION PREVENTION, TANKERS, INTERNATIONAL CONVENTIONS, PETROLEUM INDUSTRY,
C-1455-76 REGULATIONS, DESIGN AND ENGINEERING, REFINERIES, ECONOMIC EFFECTS,
C-1477-76 REGULATIONS, REFINERIES, WASTEWATER TREATMENT, *PRIMARY TREATMENT, *SECOND AND TERTIARY TREATMENT,
C-1547-76 REGULATIONS, WASTE OIL TREATMENT, REFINING, RECYCLING, LEGISLATION,

C-1560-76 REGULATIONS, PERSONNEL TRAINING, POLLUTION PREVENTION, OIL SPILLS, CLEANUP, CONTINGENCY PLANNING,
C-1594-76 REGULATIONS, ECONOMIC EFFECTS, POLLUTION PREVENTION,
C-1618-76 REGULATIONS, ECONOMIC EFFECTS, POLLUTION PREVENTION, OFFSHORE-DEVELOPMENT, LEGISLATION,
C-1640-76 REGULATIONS, OFFSHORE-DEVELOPMENT, FLORIDA COAST, ENVIRONMENTAL EFFECTS,
C-1646-76 REGULATIONS, OFFSHORE-DRILLING, OFFSHORE-DEVELOPMENT, OCS, ENVIRONMENTAL PROTECTION,
C-1655-76 REGULATIONS, OIL SHALE DEVELOPMENT, LAW ENFORCEMENT, ENVIRONMENTAL PROTECTION,
C-1676-76 REGULATIONS, BIODEGRADATION, EMULSIFICATION, CRANKCASE OIL, WATER QUALITY,
C-1720-76 REGULATIONS, POLLUTION PREVENTION, TANKERS, OIL TRANSPORT,
C-1731-76 REGULATIONS, BLOWOUT PREVENTION, DRILLING, CANADA,
C-1733-76 REGULATIONS, GUIDELINES, GERMANY, WEST, POLLUTION PREVENTION, PERSONNEL TRAINING,
C-1737-76 REGULATIONS, PETROLEUM INDUSTRY, PIPELINES, WASTEWATER TREATMENT, EUROPE,
C-1273-76 REMOTE SENSING, OIL SLICKS, DESIGN AND ENGINEERING,
C-1274-76 REMOTE SENSING, DETECTION, MONITORING, OIL SPILLS,
C-1275-76 REMOTE SENSING, OIL SLICKS, ESTUARIES, DELAWARE,
C-1276-76 REMOTE SENSING, MODELS, OIL SLICKS, COASTS,
C-1277-76 REMOTE SENSING, OFFSHORE-DEVELOPMENT, OCS, *ONSHORE IMPACTS,
C-1278-76 REMOTE SENSING, ALASKA/GULF OF, OIL SPILLS, MOVEMENT, SPREADING,
C-1279-76 REMOTE SENSING, MONITORING, OIL DISCHARGES,
C-1280-76 REMOTE SENSING, MODELS, OIL SLICKS, WATER QUALITY,
C-1367-76 REMOTE SENSING, OIL SPILLS, RECOVERY, SOURCE IDENTIFICATIONS, DESIGN AND ENGINEERING,
C-1603-76 RESOURCE MANAGEMENT, BALTIC SEA,
C-1420-76 RESTORATION, OIL SPILLS, SOIL, CLEANUP, BIODEGRADATION,
C-1421-76 RESTORATION, BIRDS, *TREATMENT PROCEDURES,
C-1393-76 REUSE, WASTE OIL, ABSORPTION,
C-1498-76 REUSE, WASTE OIL DISPOSAL , RECOVERY, RECYCLING,
C-1511-76 REUSE, WASTE OIL DISPOSAL , RECYCLING,
C-1524-76 REUSE, WASTEWATER TREATMENT, SHIPS, OIL-WATER SEPARATION,
C-1542-76 REUSE, PETROCHEMICALS,
C-1297-76 RIVERS, CHEMICAL ANALYSIS, HYDROCARBONS, SEDIMENTS, CHROMATOGRAPHY, SPECTROMETRY,
C-1298-76 RIVERS, ANALYTICAL TECHNIQUES, CHROMATOGRAPHY, SPECTROMETRY, HYDROCARBONS,
C-1588-76 RIVERS, BIOLOGICAL EFFECTS, CRUDE OIL, CONTAMINATION, INVERTEBRATES, RIVERS, *OIL-TREATED SUBSTRATES,
C-1671-76 RIVERS, BIODEGRADATION, CRUDE OIL, BACTERIA, SEDIMENT, *ACINETOBACTER,
DEVELOPMENT, MARINE ORGANISMS,
C-1258-76 SAMPLING, MONITORING, MEDITERRANEAN SEA, CHEMICAL ANALYSIS, INTERNATIONAL AGREEMENTS,

C-1262-76 SAMPLING, MONITORING, GROUNDWATER, CONTAMINATION, DETECTION,
C-1281-76 SAMPLING, CRUDE OIL, OIL-WATER SEPARATION, *CENTRIFUGATION,
C-1282-76 SAMPLING, HYDROCARBONS, PACIFIC OCEAN, *TANKER ROUTES,
C-1285-76 SAMPLING, CHEMICAL ANALYSIS, NATURAL SEEPAGE, OIL WELLS, ALASKA/GULF OF,
C-1302-76 SAMPLING, CHEMICAL ANALYSIS, CHROMATOGRAPHY, HYDROCARBONS, SEDIMENTS, SEAWATER,
C-1306-76 SAMPLING, CHEMICAL ANALYSIS, SEDIMENTS, OIL SPILLS, CHESAPEAKE BAY,
C-1308-76 SAMPLING, SOURCE IDENTIFICATION, OIL SPILLS, ANALYTICAL TECHNIQUES, CHROMATOGRAPHY, SPECTROSCOPY,
C-1310-76 SAMPLING, SOURCE IDENTIFICATION, OIL SPILLS, OIL SLICKS, ANALYTICAL TECHNIQUES, WEATHERING,
C-1312-76 SAMPLING, SOURCE IDENTIFICATION, HYDROCARBONS, MEXICO/GULF OF, OFFSHORE-PRODUCTION, NATURAL SEEPAGE, PRODUCTION, BIOLOGICAL EFFECTS, MARINE ORGANISMS,
C-1631-76 SANTA BARBARA CHANNEL, OFFSHORE-DRILLING, EIS, OIL SPILLS,
C-1649-76 SANTA BARBARA CHANNEL, OFFSHORE-DEVELOPMENT, NATURAL SEEPAGE, OIL SPILLS,
C-1660-76 SANTA BARBARA CHANNEL, EIS, OFFSHORE-DEVELOPMENT, OCS, ENVIRONMENTAL EFFECTS, OIL-GAS LEASING,
C-1259-76 SARGASSO SEA, MONITORING, SOURCE IDENTIFICATION, TAR,
C-1302-76 SEAWATER, CHEMICAL ANALYSIS, CHROMATOGRAPHY, HYDROCARBONS, SEDIMENTS, SAMPLING,
C-1674-76 SEAWATER, BIODEGRADATION, OIL SLICKS,
C-1291-76 SEDIMENTS, CHEMICAL ANALYSIS, ANALYTICAL TECHNIQUES, CHROMATOGRAPHY, HYDROCARBONS,
C-1297-76 SEDIMENTS, CHEMICAL ANALYSIS, HYDROCARBONS, RIVERS, CHROMATOGRAPHY, SPECTROMETRY,
C-1302-76 SEDIMENTS, CHEMICAL ANALYSIS, CHROMATOGRAPHY, HYDROCARBONS, SEAWATER, SAMPLING,
C-1306-76 SEDIMENTS, CHEMICAL ANALYSIS, SAMPLING, OIL SPILLS, CHESAPEAKE BAY,
C-1605-76 SEDIMENTS, CRUDE OIL, ENVIRONMENTAL EFFECTS, JAPAN,
C-1611-76 SEDIMENTS, CHEMICAL ANALYSIS, HYDROCARBONS, COASTS, FRANCE,
C-1685-76 SEDIMENTS, BIODEGRADATION, HYDROCARBONS, BACTERIA, ATLANTIC COAST,
C-1688-76 SEDIMENTS, BIODEGRADATION, BACTERIA, CHESAPEAKE BAY, CHEMICAL ANALYSIS, HYDROCARBONS,
C-1696-76 SEDIMENTS, DECOMPOSITION, *ANAEROBIC CONDITIONS,
C-1707-76 SEDIMENTS, HYDROCARBONS, CHEMICAL ANALYSIS,
C-1426-76 SEGREGATED BALLAST , REGULATIONS, TANKERS, *U.S. COAST GUARD,
C-1449-76 SEGREGATED BALLAST , DESIGN AND ENGINEERING, TANKERS,
C-1254-76 SHIPS, MONITORING, OIL DISCHARGES, BALLAST, DETECTION,
C-1381-76 SHIPS, RECOVERY, OIL SPILLS, WASTE OIL, ABSORPTION, *LIPOPHILIC FIBERS,
C-1429-76 SHIPS, OIL TRANSPORT, TANKERS, PIPELINES, OIL SPILLS, *RISK ANALYSIS,

C-1445-76	SHIPS, POLLUTION PREVENTION, PORTS, TANKERS,
C-1468-76	SHIPS, WASTEWATER TREATMENT, BILGES, DESIGN AND ENGINEERING,
C-1474-76	SHIPS, WASTE OIL DISPOSAL , INCINERATION, DESIGN AND ENGINEERING,
C-1480-76	SHIPS, DESIGN AND ENGINEERING, WASTEWATER TREATMENT, BILGES, BALLAST,
C-1487-76	SHIPS, OIL-WATER SEPARATION, COALESCENCE, DESIGN AND ENGINEERING,
C-1496-76	SHIPS, WASTEWATER TREATMENT, OIL-WATER SEPARATION, *SURFACE CHEMISTRY PARAMETERS,
C-1524-76	SHIPS, WASTEWATER TREATMENT, OIL-WATER SEPARATION, REUSE,
C-1730-76	SHIPS, INTERNATIONAL CONVENTIONS, POLLUTION PREVENTION, TANKERS, OIL DISCHARGES,
C-1248-76	SHORELINES, BIOLOGICAL EFFECTS, OIL SPILLS, METULA OIL SPILL, BIRDS,
C-1709-76	SHORELINES, ENVIRONMENTAL EFFECTS, BIOLOGICAL EFFECTS, OIL SPILLS, MARINE ORGANISMS,
C-1379-76	SINKING AGENTS, OIL SPILLS, RECOVERY,
C-1342-76	SKIMMERS, OIL SPILLS, RECOVERY, BEAUFORT SEA, DESIGN AND ENGINEERING,
C-1343-76	SKIMMERS, OIL SPILLS, RECOVERY, OIL-WATER SEPARATION,
C-1347-76	SKIMMERS, RECOVERY, OIL SLICKS, REFINERIES,
C-1348-76	SKIMMERS, RECOVERY, OIL SPILLS, DESIGN AND ENGINEERING,
C-1351-76	SKIMMERS, RECOVERY, OIL SPILLS, BOOMS,
C-1354-76	SKIMMERS, CLEANUP, RECOVERY, OIL SPILLS,
C-1356-76	SKIMMERS, OIL SPILLS, RECOVERY, *TESTING,
C-1357-76	SKIMMERS, RECOVERY, OIL SPILLS, DESIGN AND ENGINEERING, PUGET SOUND,
C-1358-76	SKIMMERS, RECOVERY, OIL SLICKS,
C-1362-76	SKIMMERS, DESIGN AND ENGINEERING, CLEANUP, OIL SPILLS,
C-1368-76	SKIMMERS, RECOVERY, OIL SPILLS, DESIGN AND ENGINEERING,
C-1370-76	SKIMMERS, RECOVERY, OIL SPILLS, DESIGN AND ENGINEERING,
C-1375-76	SKIMMERS, RECOVERY, DESIGN AND ENGINEERING,
C-1376-76	SKIMMERS, RECOVERY, OIL SLICKS, DESIGN AND ENGINEERING,
C-1377-76	SKIMMERS, RECOVERY, OIL SLICKS, DESIGN AND ENGINEERING,
C-1380-76	SKIMMERS, OIL SPILLS, CLEANUP, BOOMS, DISPERSANTS,
C-1384-76	SKIMMERS, RECOVERY, OIL SPILLS, DESIGN AND ENGINEERING, *EQUIPMENT TESTING,
C-1394-76	SKIMMERS, RECOVERY, OIL SLICKS, DESIGN AND ENGINEERING,
C-1397-76	SKIMMERS, RECOVERY, OIL SPILLS, DESIGN AND ENGINEERING,
C-1410-76	SKIMMERS, OIL SPILLS, RECOVERY, BOOMS, DESIGN AND ENGINEERING, *EQUIPMENT TESTING,
C-1418-76	SKIMMERS, OIL SLICKS, OIL-WATER SEPARATION, DESIGN AND ENGINEERING,
C-1461-76	SLUDGE, WASTEWATER TREATMENT, OIL-WATER SEPARATION, SOLVENTS, DISTILLATION,
C-1476-76	SLUDGE, WASTE OIL DISPOSAL , REFINERIES, INCINERATION, EMULSIONS,
C-1530-76	SLUDGE, WASTE OIL TREATMENT, REFINERIES, RECYCLING,
C-1615-76	SOCIO-ECONOMIC EFFECTS, MODELS, ENVIRONMENTAL EFFECTS, OFFSHORE-PRODUCTION, OIL SPILLS,

C-1616-76 SOCIO-ECONOMIC EFFECTS, REFINERIES, NEW HAMPSHIRE,
C-1641-76 SOCIO-ECONOMIC EFFECTS, OFFSHORE-DEVELOPMENT, BIOLOGICAL EFFECTS, ENVIRONMENTAL MANAGEMENT,
C-1654-76 SOCIO-ECONOMIC EFFECTS, ALASKA/GULF OF, OIL-GAS LEASING, OFFSHORE-DEVELOPMENT, ENVIRONMENTAL EFFECTS,
C-1420-76 SOIL, RESTORATION, OIL SPILLS, CLEANUP, BIODEGRADATION,
C-1568-76 SOIL, BIOLOGICAL EFFECTS, MICROORGANISMS, PLANTS, CRUDE OIL, FUEL OIL,
C-1582-76 SOIL, BIOLOGICAL EFFECTS, PETROCHEMICALS, MICROORGANISMS, PLANTS,
C-1714-76 SOIL, DECOMPOSITION, OIL SPILLS, FUEL OIL, WEATHERING,
C-1462-76 SOLID WASTE, WASTEWATER TREATMENT, REFINERIES, *SAFETY ASPECTS LNG,
C-1544-76 SOLID WASTE, WASTE OIL TREATMENT, RECLAMATION, CRUDE OIL, *PYROLYSIS,
C-1301-76 SOLUBILITY, CRUDE OIL, CHEMICAL ANALYSIS,
C-1697-76 SOLUTION, HYDROCARBONS, EVAPORATION, BIODEGRADATION, WEATHERING, *DISSOLUTION,*OCEAN WATERS,
C-1292-76 SOLVENTS, ANALYTICAL TECHNIQUES, HYDROCARBONS, CHROMATOGRAPHY, SPECTROSCOPY,
C-1461-76 SOLVENTS, WASTEWATER TREATMENT, OIL-WATER SEPARATION, SLUDGE, DISTILLATION,
C-1259-76 SOURCE IDENTIFICATION, MONITORING, TAR, SARGASSO SEA,
C-1283-76 SOURCE IDENTIFICATION, ANALYTICAL TECHNIQUES, CHROMATOGRAPHY, HYDROCARBONS,
C-1284-76 SOURCE IDENTIFICATION, CHEMICAL ANALYSIS, CHROMATOGRAPHY, HYDROCARBONS,
C-1286-76 SOURCE IDENTIFICATION, ANALYTICAL TECHNIQUES, CHEMICAL ANALYSIS, SPECTROSCOPY,
C-1300-76 SOURCE IDENTIFICATION, CHEMICAL ANALYSIS, OIL SPILLS, *INFRARED SPECTROPHOTOMETRY, *DISCRIMINANT ANALYSIS,
C-1308-76 SOURCE IDENTIFICATION, OIL SPILLS, ANALYTICAL TECHNIQUES, CHROMATOGRAPHY, SPECTROSCOPY, SAMPLING,
C-1309-76 SOURCE IDENTIFICATION, OIL SPILLS, SPECTROMETRY,
C-1310-76 SOURCE IDENTIFICATION, OIL SPILLS, OIL SLICKS, ANALYTICAL TECHNIQUES, WEATHERING, SAMPLING,
C-1311-76 SOURCE IDENTIFICATION, OIL SPILLS, FUEL OIL, CHEMICAL ANALYSIS, SPECTROMETRY, CHROMATOGRAPHY,
C-1312-76 SOURCE IDENTIFICATION, HYDROCARBONS, MEXICO/GULF OF, SAMPLING, OFFSHORE-PRODUCTION, NATURAL SEEPAGE,
C-1314-76 SOURCE IDENTIFICATION, CRUDE OIL, CHEMICAL ANALYSIS, CHROMATOGRAPHY,
C-1315-76 SOURCE IDENTIFICATION, CHEMICAL ANALYSIS, OIL SPILLS, *FLUORIMETRY,
C-1316-76 SOURCE IDENTIFICATION, CHEMICAL ANALYSIS, CHROMATOGRAPHY, *ASPHALTS,
C-1317-76 SOURCE IDENTIFICATION, FUELS, ANALYTICAL TECHNIQUES, CHROMATOGRAPHY,
C-1289-76 SPECTROMETRY, CHEMICAL ANALYSIS, HYDROCARBONS, ALASKA/GULF OF, CHROMATOGRAPHY, *BASELINE STUDIES,
C-1295-76 SPECTROMETRY, ANALYTICAL TECHNIQUES, CRUDE OIL, FUEL OIL, *INFRARED SPECTROPHOTOMETRY,

C-1297-76 SPECTROMETRY, CHEMICAL ANALYSIS, HYDROCARBONS, SEDIMENTS, RIVERS, CHROMATOGRAPHY,
C-1298-76 SPECTROMETRY, ANALYTICAL TECHNIQUES, CHROMATOGRAPHY, HYDROCARBONS, RIVERS,
C-1304-76 SPECTROMETRY, ANALYTICAL TECHNIQUES, CHROMATOGRAPHY, AROMATIC HYDROCARBONS , CARCINOGENS,
C-1307-76 SPECTROMETRY, CHEMICAL ANALYSIS, HYDROCARBONS, MARINE ORGANISMS, CHROMATOGRAPHY,
C-1309-76 SPECTROMETRY, SOURCE IDENTIFICATION, OIL SPILLS,
C-1311-76 SPECTROMETRY, SOURCE IDENTIFICATION, OIL SPILLS, FUEL OIL, CHEMICAL ANALYSIS, CHROMATOGRAPHY,
C-1286-76 SPECTROSCOPY, ANALYTICAL TECHNIQUES, CHEMICAL ANALYSIS, SOURCE IDENTIFICATION,
C-1287-76 SPECTROSCOPY, CHEMICAL ANALYSIS, CHROMATOGRAPHY, ANALYTICAL TECHNIQUES,
C-1292-76 SPECTROSCOPY, ANALYTICAL TECHNIQUES, HYDROCARBONS, SOLVENTS, CHROMATOGRAPHY,
C-1308-76 SPECTROSCOPY, SOURCE IDENTIFICATION, OIL SPILLS, ANALYTICAL TECHNIQUES, CHROMATOGRAPHY, SAMPLING,
C-1313-76 SPECTROSCOPY, SOURCE IDENITFICATION, OIL SPILLS, CHEMICAL ANALYSIS,
C-1278-76 SPREADING, REMOTE SENSING, ALASKA/GULF OF, OIL SPILLS, MOVEMENT,
C-1693-76 SPREADING, OIL SLICKS, COASTS,
C-1700-76 SPREADING, MOVEMENT, OIL SPILLS, BIBLIOGRAPHIES, CLEANUP, DECOMPOSITION,
C-1701-76 SPREADING, MODELS, OIL SLICKS, DRIFT,
C-1303-76 STATISTICAL ANALYSIS, OIL SPILLS, PORTS, TANKERS, ENVIRONMENTAL EFFECTS, MODELS,
C-1427-76 STORAGE, OIL TRANSPORT, ALASKA/GULF OF, OCS, OIL SPILLS,
C-1439-76 STORAGE, CRUDE OIL, ENVIRONMENTAL PROTECTION, *SALT DOMES,
C-1734-76 STORAGE, GUIDELINES, POLLUTION PREVENTION, GROUNDWATER, OIL TRANSPORT, EUROPE,
C-1413-76 STREAMS, CONTAINMENT, RECOVERY, OIL SPILLS, HARBORS,
C-1677-76 STREAMS, BIODEGRADATION, OXIDATION, HYDROCARBONS, BACTERIA, *ARTHROBACTER SP., *MYCOBACTERIUM SP.,
C-1390-76 SURFACTANTS, OIL SPILLS, DISPERSIONS, BIODEGRADATION, *ILLUMINATION,
C-1241-76 TANKERS, OIL TRANSPORT, ALASKA/GULF OF, *GLACIAL RETREAT,
C-1303-76 TANKERS, STATISTICAL ANALYSIS, OIL SPILLS, PORTS, ENVIRONMENTAL EFFECTS, MODELS,
C-1422-76 TANKERS, OIL TRANSFER, OIL SPILLS, BANTRY BAY, POLLUTION PREVENTION,
C-1424-76 TANKERS, EIS, REGULATIONS, DESIGN AND ENGINEERING, POLLUTION PREVENTION,
C-1426-76 TANKERS, REGULATIONS, SEGREGATED BALLAST , *U.S. COAST GUARD,
C-1429-76 TANKERS, OIL TRANSPORT, SHIPS, PIPELINES, OIL SPILLS, *RISK ANALYSIS,
C-1430-76 TANKERS, OIL TRANSPORT, PETROLEUM INDUSTRY, POLLUTION PREVENTION,

C-1431-76	TANKERS, OIL TRANSPORT, DESIGN AND ENGINEERING,
C-1434-76	TANKERS, ENVIRONMENTAL EFFECTS, PORTS, BAHAMAS, OIL SPILLS,
C-1435-76	TANKERS, POLLUTION PREVENTION, LOAD-ON-TOP, OIL DISCHARGES,
C-1436-76	TANKERS, OIL TRANSPORT, INLAND, POLLUTION PREVENTION, DESIGN AND ENGINEERING,
C-1437-76	TANKERS, POLLUTION PREVENTION, REGULATIONS,
C-1438-76	TANKERS, OIL TRANSPORT, OIL SPILLS, *CAPE SEA ROUTE,
C-1440-76	TANKERS, OIL TRANSFER, DESIGN AND ENGINEERING, PORTS, POLLUTION PREVENTION,
C-1441-76	TANKERS, OIL TRANSPORT, OIL SPILLS, DESIGN AND ENGINEERING, POLLUTION PREVENTION,
C-1442-76	TANKERS, OIL SPILLS, *ICEBERGS,
C-1444-76	TANKERS, REGULATIONS, POLLUTION PREVENTION, INTERNATIONAL CONVENTIONS, PETROLEUM INDUSTRY,
C-1445-76	TANKERS, POLLUTION PREVENTION, PORTS, SHIPS,
C-1446-76	TANKERS, OIL TRANSPORT, CRUDE OIL, ENVIRONMENTAL PROTECTION,
C-1449-76	TANKERS, DESIGN AND ENGINEERING, SEGREGATED BALLAST ,
C-1466-76	TANKERS, WASTEWATER TREATMENT, BILGES,
C-1523-76	TANKERS, WASTEWATER TREATMENT, BALLAST, BACTERIA, EMULSIFICATION,
C-1540-76	TANKERS, WASTEWATER TREATMENT, WASTE OIL TREATMENT, REFINERIES,
C-1601-76	TANKERS, ENVIRONMENTAL EFFECTS, OIL SPILLS, POLLUTION PREVENTION, OFFSHORE-PRODUCTION, LIABILITY,
C-1720-76	TANKERS, REGULATIONS, POLLUTION PREVENTION, OIL TRANSPORT,
C-1725-76	TANKERS, INTERNATIONAL CONVENTIONS, OIL DISCHARGES, LOAD-ON-TOP, *DOUBLE BOTTOMS,
C-1726-76	TANKERS, INTERNATIONAL CONVENTIONS, OIL TRANSPORT, POLLUTION PREVENTION, OIL SPILLS,
C-1727-76	TANKERS, INTERNATIONAL CONVENTIONS, LAW ENFORCEMENT, POLLUTION PREVENTION, MONITORING, OIL DISCHARGES,
C-1730-76	TANKERS, INTERNATIONAL CONVENTIONS, POLLUTION PREVENTION, SHIPS, OIL DISCHARGES,
C-1732-76	TANKERS, LEGISLATION, GREAT BRITAIN, ESTUARIES, OIL DISCHARGES, BILGES,
C-1259-76	TAR, MONITORING, SOURCE IDENTIFICATION, SARGASSO SEA,
C-1635-76	TAR SANDS, ENVIRONMENTAL EFFECTS, PRODUCTION, CANADA,
C-1652-76	TAR SANDS, EIS, OIL SHALE DEVELOPMENT, ENVIRONMENTAL EFFECTS, PRODUCTION, *WESTERN U.S.,
C-1653-76	TAR SANDS, EIS, OIL SHALE DEVELOPMENT, ENVIRONMENTAL EFFECTS, PRODUCTION, *WESTERN U.S.,
C-1664-76	TEXAS, CONTAMINATION, DRILLING, *FRESHWATER AQUIFER,
C-1391-76	TOXICITY, CLEANUP, EMULSIFICATION, OIL SPILLS, MARINE ORGANISMS,
C-1450-76	TOXICITY, DESIGN AND ENGINEERING, OFFSHORE-DRILLING, *DRILLING FLUID, ENVIRONMENTAL PROTECTION,
C-1570-76	TOXICITY, PETROCHEMICALS, HEALTH HAZARDS, *LIQUID MEMBRANES,

C-1574-76	TOXICITY, CLEANUP, OIL SPILLS, CRUDE OIL, DISPERSANTS, CORAL REEFS,
C-1576-76	TOXICITY, CRUDE OIL, DISPERSANTS, FISH, INVERTEBRATES, RED SEA,
C-1580-76	TOXICITY, OIL SPILLS, EMULSIFIERS, MARINE ORGANISMS,
C-1586-76	TOXICITY, CRUDE OIL, FUEL OIL, ANNELIDS, *NEANTHES ARENACEODENTATA,
C-1592-76	TOXICITY, CRUDE OIL, HYDROCARBONS, CRUSTACEANS, *NAPHTHALENE, *GRASS SHRIMP,
C-1606-76	TOXICITY, HYDROCARBONS, AROMATIC HYDROCARBONS , BIOLOGICAL EFFECTS, BIBLIOGRAPHIES,
C-1609-76	TOXICITY, FUEL OIL, CONTAMINATION, ENVIRONMENTAL EFFECTS, DECOMPOSITION,
C-1662-76	TOXICITY, ENVIRONMENTAL EFFECTS, WASTEWATER, OFFSHORE-PRODUCTION, MARINE ORGANISMS,
C-1668-76	TOXICITY, BIODEGRADATION, CRUDE OIL, ARCTIC,
C-1684-76	TOXICITY, BIODEGRADATION, WASTEWATER TREATMENT, REFINERIES, MICROORGANISMS,
C-1692-76	TOXICITY, BIODEGRADATION, HYDROCARBONS, MICROORGANISMS, POLLUTION PREVENTION,
C-1705-76	TOXICITY, OIL SPILLS, INLAND, BIODEGRADATION,
C-1546-76	U.S. GOVERNMENT, RECYCLING, LEGISLATION, WASTE OIL TREATMENT, WASTE OIL DISPOSAL , RECLAMATION,
C-1717-76	U.S. GOVERNMENT, LEGISLATION, OFFSHORE-DEVELOPMENT, OCS, ENVIRONMENTAL PROTECTION, LIABILITY, OIL SPILLS,
C-1526-76	USSR, WASTEWATER TREATMENT, REFINERIES, *SARATOV RESERVOIR,
C-1632-76	USSR, OIL SHALE DEVELOPMENT, ENVIRONMENTAL EFFECTS, PRODUCTION,
C-1657-76	VENEZUELA, DRILLING, OIL WELLS, POLLUTION PREVENTION,
C-1628-76	VIRGINIA, REFINERIES, ENVIRONMENTAL EFFECTS, FISHERIES,
C-1425-76	WASHINGTON, OIL TRANSFER, OFFSHORE-DEVELOPMENT, OIL SPILLS,
C-1381-76	WASTE OIL, RECOVERY, OIL SPILLS, SHIPS, ABSORPTION, *LIPOPHILIC FIBERS,
C-1393-76	WASTE OIL, REUSE, ABSORPTION,
C-1556-76	WASTE OIL, RECLAMATION, *EXTRACTION TECHNIQUES,
C-1447-76	WASTE OIL DISPOSAL , DESIGN AND ENGINEERING, MANUALS, GUIDELINES, OIL SPILLS, WASTEWATER TREATMENT,
C-1469-76	WASTE OIL DISPOSAL , RECYCLING, LEGISLATION,
C-1473-76	WASTE OIL DISPOSAL , PETROCHEMICALS, DISPERSIONS,
C-1474-76	WASTE OIL DISPOSAL , SHIPS, INCINERATION, DESIGN AND ENGINEERING,
C-1476-76	WASTE OIL DISPOSAL , REFINERIES, INCINERATION, SLUDGE, EMULSIONS,
C-1482-76	WASTE OIL DISPOSAL , REFINERIES, ADSORPTION, ACTIVATED SLUDGE ,
C-1498-76	WASTE OIL DISPOSAL , RECOVERY, RECYCLING, REUSE,
C-1511-76	WASTE OIL DISPOSAL , RECYCLING, REUSE,
C-1546-76	WASTE OIL DISPOSAL , RECYCLING, LEGISLATION, U.S. GOVERNMENT, WASTE OIL TREATMENT, RECLAMATION,

C-1488-76	WASTE OIL TREATMENT, WASTEWATER TREATMENT, OIL-WATER SEPARATION, LUBRICATING OILS,
C-1489-76	WASTE OIL TREATMENT, EMULSIONS, FILTRATION, *HYDROPHOBIC FIBERS,
C-1493-76	WASTE OIL TREATMENT, OIL SPILLS, *SOLIDIFICATION,
C-1529-76	WASTE OIL TREATMENT, ABSORPTION, *BLOCK COPOLYMER FIBERS,
C-1530-76	WASTE OIL TREATMENT, SLUDGE, REFINERIES, RECYCLING,
C-1534-76	WASTE OIL TREATMENT, DESIGN AND ENGINEERING, WASTEWATER TREATMENT,
C-1540-76	WASTE OIL TREATMENT, WASTEWATER TREATMENT, REFINERIES, TANKERS,
C-1543-76	WASTE OIL TREATMENT, RECLAMATION, LUBRICATING OILS,
C-1544-76	WASTE OIL TREATMENT, RECLAMATION, CRUDE OIL, SOLID WASTE, *PYROLYSIS,
C-1545-76	WASTE OIL TREATMENT, RECLAMATION, LUBRICATING OIL, RECYCLING,
C-1546-76	WASTE OIL TREATMENT, RECYCLING, LEGISLATION, U.S. GOVERNMENT, WASTE OIL DISPOSAL , RECLAMATION,
C-1547-76	WASTE OIL TREATMENT, REFINING, RECYCLING, REGULATIONS, LEGISLATION,
C-1549-76	WASTE OIL TREATMENT, RECLAMATION, REFINING,
C-1550-76	WASTE OIL TREATMENT, RECLAMATION,
C-1551-76	WASTE OIL TREATMENT, RECLAMATION, CRANKCASE OIL, LUBRICATING OIL, FUEL OIL,
C-1552-76	WASTE OIL TREATMENT, RECLAMATION, CRANKCASE OIL,
C-1553-76	WASTE OIL TREATMENT, RECLAMATION, LUBRICATING OIL,
C-1554-76	WASTE OIL TREATMENT, RECYCLING, LUBRICATING OILS,
C-1555-76	WASTE OIL TREATMENT, RECLAMATION,
C-1557-76	WASTE OIL TREATMENT, LUBRICATING OIL, RECLAMATION,
C-1255-76	WASTEWATER, MONITORING, ANALYTICAL TECHNIQUES, HYDROCARBONS, REFINERIES,
C-1263-76	WASTEWATER, MONITORING, DETECTION, CONTAMINATION, *FLUORESCENCE, *IR AND UV LIGHT MEASUREMENT,
C-1293-76	WASTEWATER, CHEMICAL ANALYSIS, HYDROCARBONS, CHROMATOGRAPHY,
C-1318-76	WASTEWATER, CONTAINMENT, BOOMS, OIL SPILLS,
C-1483-76	WASTEWATER, GUIDELINES, REFINERIES, ECONOMIC EFFECTS,
C-1593-76	WASTEWATER, BIOLOGICAL EFFECTS, OIL SPILLS, REFINERIES, MOLLUSKS, KOREA, SOUTH,
C-1662-76	WASTEWATER, ENVIRONMENTAL EFFECTS, OFFSHORE-PRODUCTION, MARINE ORGANISMS, TOXICITY,
C-1478-76	WASTEWATER DISPOSAL , INCINERATION,
C-1501-76	WASTEWATER DISPOSAL , OIL WELLS, WASTEWATER TREATMENT, RECYCLING,
C-1522-76	WASTEWATER DISPOSAL , REFINERIES, WASTEWATER TREATMENT, POLLUTION PREVENTION,
C-1608-76	WASTEWATER DISPOSAL , ENVIRONMENTAL EFFECTS, BIOLOGICAL EFFECTS, PETROCHEMICALS,
C-1645-76	WASTEWATER DISPOSAL , OIL SHALE DEVELOPMENT, ENVIRONMENTAL EFFECTS,
C-1338-76	WASTEWATER TREATMENT, DISPERSANTS, CLEANUP, PIPELINES,

C-1374-76	WASTEWATER TREATMENT, OIL-WATER SEPARATION, EMULSIONS, COAGULATION,
C-1423-76	WASTEWATER TREATMENT, ENVIRONMENTAL PROTECTION, NORTH SEA, MONITORING, *OIL TERMINAL,
C-1447-76	WASTEWATER TREATMENT, DESIGN AND ENGINEERING, MANUALS, GUIDELINES, OIL SPILLS, WASTE OIL DISPOSAL ,
C-1448-76	WASTEWATER TREATMENT, DESIGN AND ENGINEERING, MANUALS, OIL SPILLS, BILGES, EIS,
C-1460-76	WASTEWATER TREATMENT, OIL-WATER SEPARATION, EMULSIONS,
C-1461-76	WASTEWATER TREATMENT, OIL-WATER SEPARATION, SLUDGE, SOLVENTS, DISTILLATION,
C-1462-76	WASTEWATER TREATMENT, REFINERIES, SOLID WASTE, *SAFETY ASPECTS LNG,
C-1463-76	WASTEWATER TREATMENT, OIL SPILLS, WATER QUALITY, GROUNDWATER,
C-1464-76	WASTEWATER TREATMENT, OIL-WATER SEPARATION, OFFSHORE-PRODUCTION, RECOVERY,
C-1465-76	WASTEWATER TREATMENT, OIL-WATER SEPARATION, BILGES,
C-1466-76	WASTEWATER TREATMENT, BILGES, TANKERS,
C-1467-76	WASTEWATER TREATMENT, OIL-WATER SEPARATION, ADSORPTION,
C-1468-76	WASTEWATER TREATMENT, SHIPS, BILGES, DESIGN AND ENGINEERING,
C-1470-76	WASTEWATER TREATMENT, OIL-WATER SEPARATION, EMULSIONS, FLOCCULATION,
C-1471-76	WASTEWATER TREATMENT, OIL-WATER SEPARATION, DESIGN AND ENGINEERING, ADSORPTION,
C-1472-76	WASTEWATER TREATMENT, OIL-WATER SEPARATION, *ELECTROLYSIS,
C-1475-76	WASTEWATER TREATMENT, OIL-WATER SEPARATION, EMULSIONS, COALESCENCE,
C-1477-76	WASTEWATER TREATMENT, REFINERIES, REGULATIONS, *PRIMARY TREATMENT, *SECOND AND TERTIARY TREATMENT,
C-1479-76	WASTEWATER TREATMENT, COALESCENCE, EMULSIONS,
C-1480-76	WASTEWATER TREATMENT, DESIGN AND ENGINEERING, SHIPS, BILGES, BALLAST,
C-1481-76	WASTEWATER TREATMENT, REFINERIES, ECONOMIC EFFECTS, OIL-WATER SEPARATION,
C-1484-76	WASTEWATER TREATMENT, REFINERIES, OIL-WATER SEPARATION, FILTRATION, FLOCCULATION,
C-1485-76	WASTEWATER TREATMENT, RECOVERY, HYDROCARBONS, ADSORPTION,
C-1486-76	WASTEWATER TREATMENT, ADSORPTION, *FOAM PELLETS,
C-1488-76	WASTEWATER TREATMENT, WASTE OIL TREATMENT, OIL-WATER SEPARATION, LUBRICATING OILS,
C-1490-76	WASTEWATER TREATMENT, REFINERIES, FLOCCULATION, COAGULATION,
C-1491-76	WASTEWATER TREATMENT, OIL-WATER SEPARATION, EMULSIONS, COALESCENCE,
C-1492-76	WASTEWATER TREATMENT, OIL-WATER SEPARATION, ADSORPTION,
C-1494-76	WASTEWATER TREATMENT, OIL-WATER SEPARATION, FLOCCULATION, ADSORPTION,
C-1495-76	WASTEWATER TREATMENT, BALLAST, OIL DISCHARGES, ENVIRONMENTAL PROTECTION, *OIL LOADING TERMINAL,

C-1496-76	WASTEWATER TREATMENT, OIL-WATER SEPARATION, SHIPS, *SURFACE CHEMISTRY PARAMETERS,
C-1497-76	WASTEWATER TREATMENT, OIL-WATER SEPARATION, EMULSIONS, FLOCCULATION,
C-1499-76	WASTEWATER TREATMENT, FLOCCULATION, OIL-WATER SEPARATION, FILTRATION,
C-1500-76	WASTEWATER TREATMENT, OIL-WATER SEPARATION, EMULSIONS, FLOCCULATION,
C-1501-76	WASTEWATER TREATMENT, OIL WELLS, WASTEWATER DISPOSAL , RECYCLING,
C-1502-76	WASTEWATER TREATMENT, OIL-WATER SEPARATION, FLOCCULATION, FILTRATION,
C-1503-76	WASTEWATER TREATMENT, OIL-WATER SEPARATION, FLOCCULATION, FLOTATION,
C-1504-76	WASTEWATER TREATMENT, OIL-WATER SEPARATION, EMULSIONS, COALESCENCE,
C-1505-76	WASTEWATER TREATMENT, REFINERIES, OXIDATION,
C-1506-76	WASTEWATER TREATMENT, REFINERIES, DESIGN AND ENGINEERING, FILTRATION, ADSORPTION,
C-1507-76	WASTEWATER TREATMENT, OIL-WATER SEPARATION, *VACUUM STRIPPING,
C-1508-76	WASTEWATER TREATMENT, OIL-WATER SEPARATION, ADSORPTION,
C-1509-76	WASTEWATER TREATMENT, PETROCHEMICALS, ACTIVATED SLUDGE ,
C-1510-76	WASTEWATER TREATMENT, REFINERIES, ENVIRONMENTAL EFFECTS, FISHERIES,
C-1512-76	WASTEWATER TREATMENT, OIL-WATER SEPARATION, FLOCCULATION, FILTRATION, DESIGN AND ENGINEERING,
C-1514-76	WASTEWATER TREATMENT, PETROCHEMICALS, ADSORPTION, *ACTIVATED CARBON,
C-1515-76	WASTEWATER TREATMENT, OIL-WATER SEPARATION,
C-1516-76	WASTEWATER TREATMENT, OIL-WATER SEPARATION, DESIGN AND ENGINEERING,
C-1517-76	WASTEWATER TREATMENT, OIL-WATER SEPARATION,
C-1518-76	WASTEWATER TREATMENT, OIL-WATER SEPARATION, REFINERIES, FLOTATION, EMULSIONS,
C-1519-76	WASTEWATER TREATMENT, OIL-WATER SEPARATION, BILGES, FILTRATION,
C-1520-76	WASTEWATER TREATMENT, OIL-WATER SEPARATION, ADSORPTION, *MAGNETIC FE PARTICLES,
C-1521-76	WASTEWATER TREATMENT, REFINERIES, ADSORPTION, DESIGN AND ENGINEERING,
C-1522-76	WASTEWATER TREATMENT, REFINERIES, WASTEWATER DISPOSAL , POLLUTION PREVENTION,
C-1523-76	WASTEWATER TREATMENT, TANKERS, BALLAST, BACTERIA, EMULSIFICATION,
C-1524-76	WASTEWATER TREATMENT, SHIPS, OIL-WATER SEPARATION, REUSE,
C-1525-76	WASTEWATER TREATMENT, GUIDELINES, PETROLEUM INDUSTRY, REFINERIES,
C-1526-76	WASTEWATER TREATMENT, REFINERIES, USSR, *SARATOV RESERVOIR,
C-1527-76	WASTEWATER TREATMENT, MODELS, ECONOMIC EFFECTS, PETROCHEMICALS, *OLEFIN PRODUCTION,

C-1528-76	WASTEWATER TREATMENT, OIL-WATER SEPARATION, DESIGN AND ENGINEERING, ABSORPTION,
C-1531-76	WASTEWATER TREATMENT, EMULSIONS, OIL-WATER SEPARATION, FLOCCULATION,
C-1532-76	WASTEWATER TREATMENT, EMULSIONS, FLOCCULATION, FILTRATION,
C-1533-76	WASTEWATER TREATMENT, REFINERIES, MONITORING, WATER QUALITY,
C-1534-76	WASTEWATER TREATMENT, DESIGN AND ENGINEERING, WASTE OIL TREATMENT,
C-1535-76	WASTEWATER TREATMENT, OIL-WATER SEPARATION, REFINERIES, FLOTATION, FLOCCULATION,
C-1536-76	WASTEWATER TREATMENT, OIL-WATER SEPARATION, ABSORPTION,
C-1537-76	WASTEWATER TREATMENT, OIL-WATER SEPARATION, CRUDE OIL, HYDROCARBONS, *POLYETHYLENE POWDER,
C-1538-76	WASTEWATER TREATMENT, OIL-WATER SEPARATION, ADSORPTION,
C-1539-76	WASTEWATER TREATMENT, REFINERIES,
C-1540-76	WASTEWATER TREATMENT, WASTE OIL TREATMENT, REFINERIES, TANKERS,
C-1541-76	WASTEWATER TREATMENT, OIL-WATER SEPARATION, FLOCCULATION,
C-1684-76	WASTEWATER TREATMENT, BIODEGRADATION, REFINERIES, TOXICITY, MICROORGANISMS,
C-1737-76	WASTEWATER TREATMENT, PETROLEUM INDUSTRY, REGULATIONS, PIPELINES, EUROPE,
C-1280-76	WATER QUALITY, REMOTE SENSING, MODELS, OIL SLICKS,
C-1463-76	WATER QUALITY, WASTEWATER TREATMENT, OIL SPILLS, GROUNDWATER,
C-1533-76	WATER QUALITY, REFINERIES, WASTEWATER TREATMENT, MONITORING,
C-1676-76	WATER QUALITY, BIODEGRADATION, REGULATIONS, EMULSIFICATION, CRANKCASE OIL,
C-1716-76	WATER QUALITY, LEGISLATION, GROUNDWATER, CONTAMINATION, DRILLING,
C-1310-76	WEATHERING, SOURCE IDENTIFICATION, OIL SPILLS, OIL SLICKS, ANALYTICAL TECHNIQUES, SAMPLING,
C-1695-76	WEATHERING, CHEMICAL EFFECTS, PHYSICAL EFFECTS, DISPERSIONS, CHEMICAL,ANALYSIS, CRUDE OIL,
C-1697-76	WEATHERING, HYDROCARBONS, EVAPORATION, BIODEGRADATION, *DISSOLUTION, *OCEAN WATERS,
C-1703-76	WEATHERING, HYDROCARBONS, ANALYTICAL TECHNIQUES, BIODEGRADATION, ENVIRONMENTAL EFFECTS,
C-1714-76	WEATHERING, DECOMPOSITION, OIL SPILLS, FUEL OIL, SOIL,

APPENDIX

Periodicals Reviewed

Abstracts on Health Effects of Environmental Pollutants
Alaska Seas and Coasts
Alternatives: Perspectives on Society and Environment
Ambio
American Fisheries Society Transactions
Applied Microbiology
Applied Science & Technology Index
Aquatic Sciences & Fisheries Abstracts
Audubon
Australian Science Index
Berichte der Deutschen Wissenschaftlichen Kommision für Meeresforschung
Biological Abstracts
Bioscience
British Birds
Bulletin of Environmental Contamination and Toxicology
California Water Pollution Control Association Bulletin
Chemical Abstracts
Chemical and Engineering News
Chemical Engineering
Chemical Engineering Progress
Chemical Week
Chemistry in Canada
Chemosphere
Current Contents: Life Sciences
Current Contents: Physical and Chemical Sciences
Deep-Sea Research
Ecolibrium
Ecological Abstracts
Ecological Society of America Bulletin
Ecology Law Quarterly
Energy Review
Environment
Environment Abstracts
Environmental Action
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Environmental Health and Pollution Control
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Environmental Periodicals Bibliography
Environmental Pollution
Environmental Science & Technology
Environmental Technology and Economics
EPA Reports Bibliography Quarterly
Erdöl und Kohle Erdgas Petrochemie vereinigt mit Brennstoffchemie
Estuarine and Coastal Marine Science

Fuel Abstracts and Current Titles
Government Reports Announcements
IMS Newsletter
India Journal of Environmental Health
Industrial Wastes Information Bulletin
International Aerospace Abstracts
International Journal of Ecology and Environmental Science
International Journal of Environmental Analytical Chemistry
International Petroleum Abstracts
Iranian Journal of Science and Technology
Journal of Canadian Petroleum Technology
Journal of Chromatography
Journal of Environmental Sciences
Journal of Petroleum Technology
Journal of the Fisheries Research Board of Canada
Limnology and Oceanography
Marine Biological Association of the United Kingdom, Journal
Marine Biology
Marine Chemistry
Marine Fisheries Review
Marine Geology
Marine Geotechnology
Marine Newsletter
Marine Pollution Bulletin
Marine Science Contents Tables
Marine Technology Society, Journal
Maritime Research Information Service Abstracts
Massachusetts Audubon
Microbial Ecology
National Fisherman
National Petroleum News
National Research Council, News Report
National Wildlife
Nature
New Technical Books
Nippon Susan Gakkai Shi. Bulletin of the Japanese Society
of Scientific Fisheries
Ocean Engineering
Ocean Industry
Ocean Management
Ocean Oil Weekly Report
Oceanic Abstracts
Oceanus
Offshore
Oil and Gas Journal
Outdoor California
Pacific Oil World
Petroleum Abstracts
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